

BIOLOGICAL ASSESSMENT
for the
Operation and Maintenance
of
Leavenworth National Fish Hatchery

U.S. Fish and Wildlife Service
Leavenworth Fisheries Complex
Leavenworth, WA

March 4, 2011

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Date: March 4, 2011

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I. INTRODUCTION

The purpose of this assessment is to determine the effects of the proposed action on species that are federally protected under the Endangered Species Act of 1973 (ESA), as amended. This Biological Assessment (BA) is intended to fulfill section 7(c) of the ESA and is intended to ensure that proposed management activities would not likely jeopardize the continued existence of federally listed species, nor result in the destruction or adverse modification of designated critical habitat, as defined in the Endangered Species Consultation Handbook (USFWS 1998a).

In previous consultations with the U.S. Fish and Wildlife Service (USFWS) on Leavenworth National Fish Hatchery (LNFH) operations (USFWS 1999 & 2002), the agency concluded that LNFH's operations, including its water intake system, were not likely to adversely affect ESA listed bull trout (*Salvelinus confluentus*) or other USFWS listed species under the ESA. However, in 2006, the USFWS determined that LNFH operations were likely to adversely affect bull trout but was not likely to result in jeopardy to the species. The 2006 BA and Biological Opinion (BO) (13260-2006-P-0010) (USFWS 2006 & USDI 2006) were later modified and remanded, and culminated in a 2008 BO (13260-2008-F-0040) (USDI 2008). These documents are hereby incorporated by reference.

The 2008 BO was in effect until a 9th Circuit Court of Appeals decision (*Wild Fish Conservancy v. Salazaar*) was rendered on December 7, 2010, finding the BO was arbitrary and capricious. In addition, the USFWS issued its final rule designating critical habitat for the bull trout (U.S. Department of Interior (USDI) (75 FR 63898) on October 18, 2010. Effective November 17, 2010, the action area now includes designated critical habitat for the bull trout. For these reasons, the LNFH requests reinitiation of consultation on the effects of LNFH operations and maintenance on the bull trout and its critical habitat.

This BA provides updated information on hatchery operations and maintenance and an updated assessment on potential effects of the hatchery on ESA listed species and critical habitat. LNFH is reinitiating formal ESA consultation for all aspects of the operation and maintenance of the hatchery to ensure that proposed management activities will not likely jeopardize the continued existence of listed species nor adversely modify critical habitat.

II. PROJECT LOCATION

A. Legal Description

Township 24N, Range 17E, Section 23 & 26

B. General Location

LNFH is located three miles south of Leavenworth, Washington, near the mouth of Icicle Canyon. LNFH withdraws surface water from Icicle Creek at river mile (rm) 4.5 and returns water to the creek at approximately rm 2.8. LNFH also operates and manages three lakes/reservoirs (Lower Snow, Upper Snow and Nada Lakes) located approximately seven miles from the hatchery and about one mile above it in elevation in the Alpine Lakes Wilderness Area. Water leaves these lakes via Snow Creek and enters Icicle Creek at rm 5.5 (Figure 1).

III. AFFECTED ACTION AREA

The affected action area for the operation and maintenance of LNFH is the Icicle Creek watershed (Figure 2). It is recognized however that fish released from LNFH also inhabit the Wenatchee River and some of its tributaries, the Columbia River and some of its tributaries, and the Pacific Ocean.

Icicle Creek is a major fourth order tributary to the Wenatchee River. The Wenatchee basin encompasses approximately 3,551 square kilometers (km²) (1,371 square miles (mi²)) in central Washington. The watershed heads at the Cascade crest and flows east towards the Columbia Plateau. The Wenatchee River drains into the Columbia River at the town of Wenatchee. Other major tributaries are the White and Little Wenatchee rivers, which drain into Lake Wenatchee (source of the Wenatchee River), Chiwawa River, and Nason Creek.

Icicle Creek is 31.8 miles long, with 85 tributaries, and drains a 136,759 acres (211 mi²) basin containing 14 glaciers and 102 lakes. The U.S. Forest Service (USFS) manages 87%, with 74% in the Alpine Lakes Wilderness Area, of the Icicle Creek catchment and manages it as a Tier 1 key watershed under the Northwest Forest Plan (USFS 1994). Therefore, public lands in the Icicle Creek drainage are managed for at risk salmonids and other fish species.

Icicle Creek is primarily snowmelt fed. About 21% of the flow in a hot, dry summer is estimated to originate from glacier melt (Mullan *et al.* 1992). The measured flow in Icicle Creek ranges from a minimum of 44 cubic feet per second (cfs) to a maximum of 14,100 cfs according to readings taken from the U.S. Geological Survey (USGS) gauging station (rm 5.8) located above all major water diversions. The discharge of Icicle Creek is altered by water diversions which can reduce the flow in the lower reaches to very low levels during the summer and early fall (WRWSC 1998). The City of Leavenworth and the Icicle-Peshastin Irrigation District (IPID) (Appendix A) divert water above the Snow Lakes trailhead (rm 5.7) and LNFH and Cascade Orchard Irrigation Company (COIC) divert water below the trailhead (rm 4.5). Irrigation diversions can remove 48% and 79% of the mean August and September flows, respectively (Mullan *et al.* 1992).

The Icicle Creek watershed has a long history of human impacts beginning with sheep herding and mining in the late 1800s. Recent uses include timber harvest, road building, fire suppression, campground development, private residences, commercial development, and recreation. Five percent of Icicle Creek's watershed, outside of the wilderness boundary, has been directly impacted by logging (USFS 1994a). Road building has occurred for development, recreation, and timber harvest. Over 11% of the vegetation along lower Icicle Creek has been removed from private property (WRWSC 1998). The Icicle Creek watershed is a popular recreation area for hikers, rock climbers, fishermen, and many others. Natural disturbances such as fires and landslides are prevalent in the watershed.

Upper Icicle Creek is rated Class AA and Lower Icicle Creek is rated Class A surface water by the Washington State Department of Ecology (WDOE). Water quality concerns in Icicle Creek and the main stem Wenatchee River include not meeting Washington State 303(d) standards for water temperature, dissolved oxygen, pH, in-stream flow, total polychlorinated biphenyls (PCBs), and ammonia-N. Also, the Wenatchee River does not meet standards for 2,3,7,8-TCCDD TEQ and 4,4'-DDE (WDOE 2008).

Salmonid species present in the watershed include hatchery spring Chinook salmon (*Oncorhynchus tshawytscha*), hatchery coho salmon (*O. kisutch*), steelhead (*O. mykiss*), sockeye salmon (*O. nerka*), bull trout, non-native brook trout (*Salvelinus fontinalis*), westslope cutthroat trout (*O. clarki lewisi*), redband trout (*O. mykiss gairdneri*), and mountain whitefish (*Prosopium williamsoni*). There are also native and non-native non-salmonids in Icicle Creek including dace (*Rhinichthys* spp.), lamprey (*Lampetra* spp.), sculpin (*Cottus* spp.), suckers (*Catostomus* spp.), and others.

IV. LISTED SPECIES IN THE ACTION AREA

Nine threatened and endangered species, four designated critical habitats, three candidate species, and 30 species of concern under USFWS jurisdiction are listed in Chelan County, Washington (Appendix C).

The species marbled murrelet (*Brachyramphus marmoratus*), fisher (*Martes pennant*) – West Coast Distinct Population Segment (DPS) (west of the Okanogan River), yellow-billed cuckoo (*Coccyzus americanus*), North American wolverine (*Gulo gulo luteus*), Wenatchee mountains checker-mallow (*Sidalcea oregano* var. *calva*), showy stickseed (*Hackelia venusta*), and Ute ladies'-tresses (*Spiranthes diluvialis*) are not present in the action area. The action area is outside the range of marbled murrelet and the project area does not meet the habitat requirements for this species. Fishers and the yellow-billed cuckoo are thought to have been extirpated from Washington state in the 1930s. There have been no recorded sightings of these species in Icicle Creek or in the Wenatchee National Forest (Jannett Millard, USFWS, Leavenworth, WA., pers. comm. 2004). Suitable habitat for listed plant species may be present in the action area but will not be disturbed by the proposed project. Also, the action area is not within the critical habitat boundaries for Canada lynx (*Lynx Canadensis*), northern spotted owl (*Strix occidentalis caurina*), or Wenatchee mountains checker-mallow. Therefore, LNFH operations and maintenance will have “no effect” on marbled murrelet, fisher, yellow-billed cuckoo, Wenatchee mountains checker-mallow, showy stickseed, Ute ladies'-tresses, Canada lynx critical habitat, northern spotted owl critical habitat, or Wenatchee mountains checker-mallow critical habitat and these species or critical habitat will not be discussed further.

Endangered or threatened species and critical habitat within the action area that may be affected include gray wolf (*Canis lupus*), bull trout, bull trout critical habitat, Canada lynx, grizzly bear (*Ursus arctos horribilis*), and northern spotted owl. Descriptions of and potential effects to these species and critical habitat are discussed in this BA.

V. FORESEEABLE FUTURE ACTIONS IN THE ICICLE CREEK WATERSHED

For the purpose of this BA, this section both describes actions that already have occurred (and are part of the baseline if fully implemented) and suggests future actions that may be subject to section 7 of the ESA. Additional mechanisms for implementation of these actions may be Habitat Conservation Plans or other section 10 permits.

A. Icicle Creek Restoration Project

The original design of LNFH, built between 1939 and 1941, involved managing stream flow between a hatchery channel with an energy control structure at the base and holding structures and weirs in the historical creek channel (rm 2.8 to 3.8)(Figure 1). As a result of these structures, migration of endangered steelhead, threatened bull trout, and many other fish species was affected. To address this issue, the USFWS in cooperation with the USFS and U.S Bureau of Reclamation (BOR) identified and partially implemented the Icicle Creek Restoration Project (ENSR 2000; USFWS 2001, 2001a, 2002a, 2002b, & 2004). The Icicle Creek Restoration Project was separated into two phases. Phase I was implemented and completed in 2003. Phase I included removal of Structure 2 except the head gate and removal of all of Structures 3 and 4. The purpose and need of Phase II was to provide long-term, sustainable year-round passage to native fish through LNFH grounds and provide riverine fish habitat within LNFH grounds. Implementation of Phase II has been delayed due to legal action, citizen and agency concerns,

funding, and delays in receiving needed permits and approvals. LNFH will continue efforts to improve fish passage through its grounds. When project specific details are determined, they will undergo a separate ESA consultation.

B. LNFH'S Water Supply System Rehabilitation Project

The purpose of the LNFH's Water Supply System Rehabilitation Project was to upgrade fish protection and passage facilities at its point of diversion and replace structural components of the intake facility and water delivery system that are degraded and failing (Sverdrup 2000; USFWS 2003 & 2004a). Implementation of this project has been delayed due to legal action, citizen and agency concerns, funding, and delays in receiving needed permits and approvals. LNFH will continue efforts to improve its water delivery system. When project specific details are determined, they will undergo a separate ESA consultation.

C. Freshwater Fisheries Management

Washington, Oregon, and the four treaty Native American tribes (Yakama, Warm Springs, Umatilla, and Nez Perce), that are parties to the Columbia River Fish Management Plan (US v Oregon), prepare harvest strategies for the main stem Columbia River based on run size predictions made by their respective fishery agencies. They jointly present their findings to the Columbia River Compact through the Technical Advisory Committee (TAC). The Columbia River Compact, created by Congress, has the authority to approve or reject sport and commercial fishery proposals for the main stem Columbia River. In their deliberations, the Compact considers the findings of the TAC. If findings are in compliance with the management plan, broodstock stock goals, ESA guidelines, and the run size prediction shows a harvestable surplus, the Compact sets a season for non-tribal and/or tribal fisheries in the main stem Columbia River.

If a harvestable surplus is predicted for Icicle Creek, the State of Washington and Yakama Nation set regulations for terminal area non-tribal sport and/or tribal subsistence fisheries. Fishing regulations are established to also provide adequate escapement for hatchery production and meet ESA guidelines. The sport anglers fish from approximately rm 0 to 2.7 while the tribal anglers fish the spillway pool at rm 2.8. The tribal fishery is one of only three dip net fisheries in the state. The sport and tribal fisheries typically open in early to mid-May and conclude towards the end of July. Fishing effort within the two fisheries is similar with peak effort occurring during the latter part of May through mid-June. This is the time of peak upstream movement of spring Chinook through Icicle Creek. Beyond June fewer new fish arrive in Icicle Creek and the physical condition of fish already present begins to deteriorate.

D. Yakama Nation's Coho Reintroduction Project

The Yakama Nation's Coho Reintroduction Project is part of the Yakima/Klickitat Fisheries Project that involves ongoing studies, research, and artificial production of several salmonid species in the Yakima and Klickitat river basins. The Yakima/Klickitat Fisheries Project is funded by the Bonneville Power Administration (BPA) and is co-managed by the Yakama Nation and the Washington Department of Fish and Wildlife (WDFW). LNFH supports the

Yakama Nation's Coho Reintroduction Project by providing hatchery facilities for part of its expanded coho salmon production program. The Yakama Nation in conjunction with the BPA consulted with the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries) and the USFWS on this project (FWS Reference Number 01-I-EO231) and this program will not be addressed further in this BA. Also, BPA is currently developing an Environmental Impact Statement for the Coho Reintroduction Project's future programs.

E. Other

The Draft Upper Columbia River Salmon Recovery Plan (UCSRB 2005) lists actions which are likely to occur in the foreseeable future and include: Lower Icicle Creek Instream Target Flow Recommendation; Streambank stabilization and riparian habitat restoration in the Lower Icicle Creek; Fish passage protection facilities at the City of Leavenworth's point of diversion; Fish passage protection facilities at the IPID's point of diversion, and campground relocation and road decommissioning on USFS Land.

Similarly, the Draft Bull Trout Recovery Plan (USFWS 2002c, Chapter 22-Upper Columbia Recovery Unit) identified a number of recovery tasks, including (as applies to the Icicle Creek watershed) the improvement of low flow conditions; screening irrigation diversions; correcting irrigation passage barriers; protecting high quality habitats; improving various water quality parameters; reconnecting floodplains; enforcing placer mining regulations; and assessing/correcting various road impacts, fish passage at LNFH, non-native fish impacts, and fish harvest impacts. Some of these actions have already been implemented, at least to some degree, and others are likely to also occur in the foreseeable future.

VI. PROPOSED ACTION (OPERATION AND MAINTENANCE OF LNFH)

A. Background

LNFH was authorized by the Grand Coulee Fish Maintenance Project, April 3, 1937 and reauthorized by the Mitchell Act (52 Stat. 345), May 11, 1938. The Mitchell Act authorized the Secretary of Commerce "...to establish one or more salmon cultural stations in the Columbia Basin in each of the states of Oregon, Washington, and Idaho." LNFH is one of three mid-Columbia stations constructed by the BOR as fish mitigation facilities for the Grand Coulee Dam, Columbia Basin Project. A fourth mitigation hatchery near Chief Joseph Dam was proposed by BPA in 2006 and a Record of Decision followed on March 18, 2010. Although reauthorized by the Mitchell Act, funding for LNFH was provided through a transfer of funds from the BOR to the USFWS until 1945. From 1945 to 1993, the USFWS had funding, management, and operation responsibilities for LNFH. Beginning on October 1, 1993, the BOR reassumed funding responsibility for LNFH while the USFWS continues to manage and operate the facility.

In addition to the initial authorizations mentioned above, hatchery operations are authorized, sanctioned and influenced by the following treaties, judicial decisions and specific legislation:

- Treaty with the Walla Walla, Cayuse, Umatilla Tribes, 06/09/1855
- Treaty with the Yakama, 06/09/1855
- Treaty with the Nez Perce, 06/25/1855
- Treaty with the Tribes of Middle Oregon, 06/25/1855
- Executive Order (Treaty with Bands of Colville), 04/08/1872
- U.S. v. Oregon (Sohappy v. Smith, “Belloni Decision”, Case 899), 07/08/1969
- Endangered Species Act of 1973, 87 Stat. 884, 12/28/1973
- Salmon and Steelhead Conservation and Enhancement Act, 94 Stat. 3299, 12/22/1980
- Pacific Salmon Treaty Act of 1985 (U.S./Canada Pacific Salmon Treaty), Public Law 99-5, 16 U.S.C. 3631, 03/15/1985
- U.S. v. Colville Confederated Tribes (No. 08-35961, D.C. No. 3:68-cv-00513-KI), May 27, 2010 (reaffirmation of the Wenatchi’s Icicle Creek fishing rights)

When LNFH was first chartered, spring Chinook salmon and steelhead were identified as the primary mitigation species. The initial operating plan called for adult spring Chinook salmon and summer steelhead to be trapped at Rock Island Dam and hauled to LNFH for holding and spawning. Salmon and steelhead trapped at the Rock Island Dam represented a mix of fish destined for the upper Columbia River system. The LNFH was considered to be the primary adult holding and spawning site with eggs being shipped from there to the Entiat and Winthrop NFHs. However, fertilized eggs were imported from a variety of sources.

Over the years, the LNFH production program has included a variety of species including spring and summer Chinook, coho, steelhead, kokanee, and various resident salmonids. Since 1974, spring Chinook salmon have been the priority species and the success of the program has allowed a sport and tribal fishery in most years.

LNFH currently rears only the “Carson lineage” stock of spring Chinook salmon. The Carson lineage stock was derived from fish captured at Bonneville Dam and genetic analysis indicate that these fish represent some unknown admixture of fish from the mid and upper Columbia and Snake River populations (Campton 2000). Enough adults return to LNFH annually to meet production targets and the hatchery has not imported eggs or fry for release into Icicle Creek for more than twenty years.

Currently, LNFH targets a release of 1.2 million spring Chinook salmon pre-smolts into Icicle Creek (approx. rm 2.7) during late April. Production goals at this facility are set by the Columbia River Fish Management Plan under U.S. vs. Oregon. Initially this plan set a production goal of 2.2 million spring Chinook salmon pre-smolts annually, but this was renegotiated in 1991 to 1.625 million (release year 1993 – 2008) and in 2008 to 1.2 million (release year 2009). The production level was reduced in 2008 per the U.S. v. Oregon 2008 – 2017 Management Agreement to improve fish health and to improve the quality of water (lower phosphorus) discharged into Icicle Creek. The migration corridor for released pre-smolts and returning adult fish includes approximately 489 river miles (2.8 rm Icicle Creek, 26 rm Wenatchee River, and

460 m Columbia River) and the Pacific Ocean. Adult salmon returning to the hatchery in excess of broodstock needs support a tribal (approx. m 2.7 to 2.8, spillway pool) and sport fishery (approx. m 0 to 2.7) in Icicle Creek. Also, excess adults entering the hatchery are given to Native America tribes for food and tribal ceremonies.

LNFH requests that this consultation cover hatchery operations and maintenance for the foreseeable future as no significant changes to operations or structural components of the hatchery are anticipated in the near term. If any changes to hatchery operations or maintenance occur such as new construction or modification of existing structures, LNFH will reinitiate consultation.

B. Fish Production and Associated Facilities

1. Broodstock Collection and Holding

Spring Chinook salmon broodstock collection at the hatchery is managed to maintain the genetic integrity of the stock. This is accomplished by ensuring that the adult broodstock is randomly collected for spawning across the run in proportion to the rate at which they return. All broodstock used for production voluntarily enter the hatchery from May into July. Adults swim up the fish ladder and into one of two holding ponds. Each holding pond measures 15 x 150 feet (ft), and they are joined in the middle by an adjustable slide gate. The gate is opened and adults are allowed to enter the second pond during sorting, counting, etc. The holding ponds supply attraction water for the ladder. The broodstock collection target is 900 adult Chinook salmon at a gender ratio of 1:1. The number of adults spawned is based on the hatchery's release goal of 1.2 million pre-smolts and on density and flow indices, which relate to the amount of available water and space.

In years with large adult returns, the fish ladder may be closed periodically for a few days to prevent overcrowding in the holding ponds while collecting broodstock. Of primary concern is the potential for significantly reduced dissolved oxygen levels which, if unchecked, can lead to fish kills. In addition, excessive numbers of fish in the holding pond exacerbate stress levels of fish (increasing oxygen demand) and increase the potential for lateral disease transmission. The strategy of occasionally closing the ladder also allows for surplusing of excess adults and for additional harvest opportunities by sport and tribal anglers.

Non-target fish of size encountered in the adult holding pond are netted and immediately returned to the spillway pool in Icicle Creek with the following exceptions: spawned adult steelhead are returned to the spillway pool (to continue downstream migration) and un-spawned adult steelhead are placed upstream of the hatchery as per consultation with NOAA Fisheries; and bull trout are handled and released according to protocols (Appendix D) established between LNFH and the USFWS Ecological Service's Central Washington Field Office (CWFO). These larger fish can be observed while sorting or counting which generally takes place weekly during broodstock collection. Smaller sized fish that fit between the crowder bars and avoid netting can remain in the holding pond until it is drained at the conclusion of the spawning season (late August). They exit to Icicle Creek via the fish ladder as the ponds are drained.

The adult holding ponds are supplied with a combination of surface water (Icicle Creek) and groundwater (well) to maintain optimal water temperatures (in the range of 55 °F) during holding. Flow into the holding ponds is managed to meet or exceed one gallon of inflow per fish per minute. Formalin (167 ppm for 1 hour) is administered to the holding ponds three days per week to combat fungal growth on the fish. The formalin (Parasite-S, Western Chemical) used in hatchery operations is U.S. Food and Drug Administration (FDA) approved for use on salmonids and the manufacturer's guidelines are followed. Antibiotics are administered via injection to the female brood one to two times prior to spawning to combat vertical transmission of bacterial kidney disease (BKD).

Surplus / Excess Protocol

If the number of salmon entering the adult holding ponds exceeds the number needed for production, the excess salmon are "surplused" to Native American tribes. There is a tiered process for distribution of federal surplus property. If tribes decline the surplus fish, then they are given to Trout Unlimited through a formalized agreement. The receiving groups assist in the excessing process under the close supervision of hatchery personnel. Prior to excessing, LNFH staff informs the individuals performing the work on proper identification and handling techniques of bull trout and steelhead. All fish species other than spring Chinook salmon will be returned to Icicle Creek by hatchery personnel.

2. Spawning

The first spawning date is mid-August and spawning is normally completed by Labor Day. Eggs are taken once per week. Ripe females are separated with an equal amount of males the day before spawning to expedite the spawning procedure. On the day of spawning a small number of fish are crowded into a lift system and then to an anesthetic vat. Once the fish are anaesthetized they are placed on a table where males and females are separated and sacrificed via a sharp blow to the head. Ripe females are bled prior to spawning. Fish carcasses are buried on LNFH grounds.

Fish are randomly selected and mated as close to a 1:1 male/female ratio as possible. Typically the sex ratio for the returning adults is skewed 60/40 in favor of the females. However, equal numbers of males and females are separated and held during the spawning activities. If needed, males may be used twice. Jacks (age-3 males) are randomly included in the spawning population at a rate not to exceed 5% of total males used per USFWS Region 1 genetics guidelines. During years of low male returns, the hatchery may exceed the 5% jack limit.

3. Incubation

Eggs from one female are placed in individual incubator trays that receive three to four gallons per minute (gpm) of ground water from the fertilization to the eyed stage rearing period. If necessary during the incubation period (August through December), eggs are treated three days per week with 1,667 ppm of formalin for fungus control. During the eyed stage, eggs with moderate to high levels of BKD and mortalities are culled and the remaining eggs enumerated.

4. Rearing

Rearing facilities include the aforementioned adult holding ponds, forty-five 8 x 80 ft raceways, fourteen 10 x 100 ft covered raceways, and 122 fiberglass tanks. The hatchery also has 40 small and 22 large Foster-Lucas ponds which are no longer in use.

Buttoned up fry are moved from incubation trays to tanks inside the nursery building for their initial feeding in mid-December. Fry are fed starter feed for the first three months. In late February/early March, fry are moved outside to thirty, 8 x 80 raceways and remain there until the previous brood year is released (late April). After release all empty rearing units are cleaned with high pressure water. Staff from the USFWS Columbia River Fisheries Program Office in Vancouver, Washington mark, inventory, and move all fish in May. All spring Chinook salmon receive an adipose fin clip and approximately 200,000 are implanted with a coded wire-tag (CWT). May is the optimal time to mark fish at this facility for a variety of reasons: 1) the fingerlings are about 100 fish/pound (lb), a good size for marking and handling; 2) fingerlings are near their maximum pond density and need to be moved; and 3) water temperatures are cool enough to facilitate successful handling.

After spawning, the two adult ponds are cleaned in preparation to receive fingerlings. Depending on the weather and surface water temperatures, sometime between December and March fish from 15 of the 8 x 80 raceways are moved to the two adult holding ponds. This action ensures the top two banks of 8 X 80 raceways are empty for the next years fry. Fish will remain in the adult ponds until release in April.

Fish are fed daily based on their size and the water temperature. Smaller fish are fed smaller amounts more often (6 to 8 feedings per day) and large fish are fed once or twice per day. Approximately 80,000 lbs of fish food are fed annually at a conversion rate of 1.2 lbs of fish feed to one lb of fish weight gain. A low phosphorus feed is used year round with the exception of fry in the nursery building.

Ponds are cleaned depending on the amount of feed expended, generally a few times per week. Cleaning entails sweeping the rearing unit with a course brush from the head end to the tail end. No cleaning agents are used and all water and waste is directed to the pollution abatement pond where waste materials settle.

5. Release

All 1.2 million spring Chinook salmon pre-smolts are force released directly from the rearing unit to Icicle Creek around the third week of April. However, an emergency fish release could occur at any time. Although an attempt is made to coincide the pre-smolt release with a high stream flow event, this facility is constrained by a spill window for Rock Island Dam negotiated with the Chelan PUD.

The size of fish at release averages 18.2 fish/lb (1994-2005 range = 16.1 – 22.5 fish/lb). This size was determined to result in a fish which is in good health at the time of release, migrates to the ocean fairly rapidly, and generates adult escapement to sustain the program and provide harvest opportunities. After release all vacant rearing units are cleaned.

The average travel time from release to McNary Dam, for release years 1998 – 2003, is 27.2 days with a minimum travel time of 20 days in 1998 to a maximum time of 35 days in 2001. McNary Dam is approximately 204 miles from LNFH. The average survival from release to McNary Dam is 57.1% with a minimum survival of 50% in 2001 to a high of 64% in 2003 (Survival Under Proportional Hazards (SURPH) database 2004).

6. Fish Health Management

The primary objective of fish health management production programs at USFWS hatcheries is to produce healthy pre-smolts that contribute to the program goals of that particular stock. Another equally important objective is to prevent the introduction, amplification, or spread of certain fish pathogens which might negatively affect the health of both hatchery and naturally producing stocks.

Fish Health Policy:

The USFWS Fish Health Center (Olympia FHC) in Olympia, Washington provides for fish health at LNFH under the USFWS Fish Health Policy (<http://www.fws.gov/policy/manual.html> Part 713) and the “Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries,” by the Integrated Hatchery Operations Team (IHOT 1996). These documents provide guidance for preventing or minimizing diseases within and outside of the hatchery. In general, movement of live fish into or out of the hatchery are approved in the U.S. v Oregon Production Advisory Committee forum and noted on the State of Washington Brood Document. If a fish transfer or release is not on the Brood Document, permits from the WDFW, the USFWS, and any other states through which the fish travel must be obtained and approved by co-managers. Fish health exams and certifications must be completed prior to any releases or transfers from the hatchery to minimize the risk of disease transmittance to other populations. Finally, any vehicle that transfers the fish or eggs is disinfected before being brought onto the station and after use at the hatchery; this also includes fish marking equipment.

Fish Health Examinations:

Routine Examination: A Fish Health Specialist visits approximately once per month to examine juvenile fish at LNFH. Juvenile fish are sampled to ascertain general health on each stock and brood year. Based on pathological signs, age of fish, and concerns of hatchery personnel, the examining Fish Health Specialist determines the appropriate tests. Tests typically include microscopic examinations of the skin, gills, and internal organs. Kidneys (and other tissues, if necessary) are checked for the common bacterial pathogens by culture and/or other tests specific for the particular pathogen of interest. Blood may be examined for signs of infection and cellular or biochemical abnormalities. Additional tests for virus or parasites are done if warranted. The Fish Health Specialist may also examine fish which are moribund or freshly dead to ascertain potential disease problems in the stocks.

Diagnostic Examination: The Fish Health Specialist conducts diagnostic exams when needed or when requested by hatchery personnel. Moribund, freshly dead fish, or fish with unusual signs or behavior are examined for disease using necropsy and appropriate diagnostic tests.

Pre-release/Transfer Examination: LNFH staff notifies Olympia FHC at least six weeks prior to a release or transfer of fish from the hatchery. Tissue samples are collected on 60 fish of the stock being transferred or released. The pathogens screened for include: infectious hematopoietic necrosis virus (IHNV); infectious pancreatic necrosis virus (IPNV); viral hemorrhagic septicemia virus (VHSV); *R. salmoninarum*; *Aeromonas salmonicida*; *Yersinia ruckeri*; and under certain circumstances other pathogens such as *Myxobolus cerebralis* and *Ceratomyxa shasta*.

Adult Certification Examination: During spawning, tissues are collected from adult fish to ascertain viral, bacterial, and parasitic infections and to provide a brood health profile for the progeny. All females used as broodstock are assigned a number and tested for *R. salmoninarum*, causative agent of BKD. This number is also used to track the eggs. All female are ranked according to the level of risk they pose to potentially passing BKD to their progeny. Typically, the eggs from high and moderate risk females are culled. However, progeny from moderate risk fish may be kept to meet production targets. Eggs and fish from moderate risk parents are reared at lower densities and in separate rearing units.

Chemotherapeutant Use:

Administration of therapeutic drugs and chemicals to fish and eggs reared at LNFH is performed only when necessary to effectively prevent, control, or treat disease conditions. All treatments are administered according to label directions in compliance with the FDA and the Environmental Protection Agency (EPA) regulations for the use of aquatic animal drugs and chemicals. EPA and FDA consider the environmental effects acceptable when the therapeutic compounds are used according to the label.

Erythromycin injections for spring Chinook salmon female broodstock are critical for management of BKD. Erythromycin treatment helps control horizontal transmission between adults in the holding pond and vertical transmission from the mother to its progeny. All female spring Chinook salmon held at LNFH are injected with erythromycin once or twice, usually in mid-July under an extra-label veterinary prescription. Injected carcasses are not used for stream nutritional enhancement or human consumption.

Adult spring Chinook salmon held in the holding ponds are administered a formalin treatment at least three times per week to control external fungus growth. The formalin (Parasite-S; Western Chemical) used in hatchery operations is FDA approved for use on salmonids and the manufacturer's guidelines are followed. The hatchery typically treats adult fish in the pond at 167 ppm for one hour using the flow through method. The manufacturers label recommends treating salmonids up to 170 ppm for water temperatures below and up to 250 ppm for temperatures above 50°F. Water temperatures in the adult ponds during treatment are above 50°F. Additional treatments may be administered upon recommendation from a Fish Health Specialist.

Periodically, the rearing fish are treated for a variety of fish diseases, both internal and external. For external treatment, the fish are provided a mild concentration of formalin or hydrogen peroxide for 15 to 60 minutes depending on the situation. For internal treatment, the fish are fed feed prepared with fish approved antibiotics for three to 10 days.

An iodine compound (approximately 1% iodine) is used to water harden and disinfect eggs after spawning. The eggs are disinfected in 130 ppm iodine in water buffered by sodium bicarbonate (at 0.01%) for 30 minutes during the water hardening process. In the event eggs are received from other hatcheries, they are also disinfected in the same manner prior to contact with the station's water, rearing units, or equipment.

Analysis of fish feed:

USFWS Abernathy Fish Technology Center (Abernathy FTC) provides routine quarterly proximate analysis of the fish food used at LNFH to ensure that it meets the feed manufacturer's specifications. If nutritional concerns arise, LNFH or Olympia FHC personnel consult with the Abernathy FTC's Fish Nutritionist.

7. Monitoring and Evaluation

USFWS's Mid-Columbia River Fishery Resource Office (MCRFRO) provides monitoring, evaluation, and coordination services concerning LNFH production. These research activities are covered under a separate scientific permit (USFWS TE-702631, MCFRO-13) and are not specifically addressed in this BA. MCRFRO staff monitors hatchery returns, straying rates, biological characteristics of the hatchery stock, fish marking, tag recovery, and other aspects of the hatchery program. They also maintain the database that stores this information. MCRFRO cooperates with the hatchery, fish health and technology centers, and co-managers to evaluate fish culture practices, assess impacts to native species, and coordinate hatchery programs both locally and regionally.

As assessed by MCRFRO, the average survival to adult (Columbia River return includes harvest and strays outside Wenatchee Basin) for completed CWT brood years 1979 – 1995 was 0.24% with a standard deviation of 0.17%. The minimum survival was 0.009% for brood year 1990 and maximum survival was 0.72% for brood year 1988. Preliminary information indicates that brood year returns (1996 – 2004) increased substantially with an average survival of 0.58% (stdev = 0.44%). CWT information provides contribution estimates to various marine and freshwater fisheries in addition to recoveries at hatcheries or spawning grounds throughout the Columbia Basin. Data compiled by MCRFRO indicates, for return years 1999 – 2006, that approximately 41% of LNFH spring Chinook were recovered at the hatchery, 24% were harvested in treaty/ceremonial fisheries (23% Icicle Creek), 18% were captured in freshwater/Columbia River sport fisheries (10% Icicle Creek), 9% were recovered on Wenatchee Basin spawning grounds (Icicle and Peshastin creeks = 6%), and 8% were harvested in freshwater/Columbia River gillnet fisheries. Less than 1% was estimated to have been harvested in marine fisheries.

C. Water Supply System

LNFB shares a point of diversion with COIC in Icicle Creek at rm 4.5. LNFB maintains and operates the intake diversion structure and its associated intake structures as part of a 1939 contract between the United States and COIC. LNFB funds the WDFW to maintain COIC's diversions, screens, and fish bypass. COIC has a 1905 water right for 12.4 cfs during the irrigation season (May 1st through October 1st) and LNFB holds a 1942 water right to divert 42 cfs year around. Table 1 lists all water rights held by LNFB.

The hatchery's water supply system consists of four major components: (1) point of diversion and gravity flow delivery system; (2) Snow/Nada Lake Basin supplementation water supply reservoirs; (3) well system on hatchery property; and 4) water discharge. Each of these four major components is described individually below.

1. Point of Diversion and Gravity Flow Delivery System

LNFB's intake facilities contain several components. The intake system relies on gravity flow to convey water from the intake to the hatchery. Primary to the LNFB water intake system is a rubble masonry diversion structure that spans Icicle Creek (rm 4.5). The low head structure is comprised of a concrete base with flash boards on top and a pool and weir fish ladder. The structure raises water elevations several feet allowing a portion of the flow to be diverted into a concrete water conveyance channel with a grizzly rack (6 inch bar spacing) at its entrance. Since 2010, from mid-July through September, LNFB staff may place a section of cyclone fence (plastic coated, 4 inch mesh) in front of the outer grizzly rack to prevent adult spring Chinook salmon from entering the conveyance channel. No fish became impinged on the fence. Water entering the conveyance channel is transported a short distance from the coarse grizzly rack to a small building which houses a fine rack (1 ½ inch bar spacing), an overflow spill section, and a sediment sluicing section. The coarse and fine racks serve to limit the size of objects that may enter the pipeline. Hatchery personnel inspect the intake structure twice daily (once at the start and once at the end of the working day, typically 7:30AM to 4:00 PM) to remove accumulated debris from racks and to ensure adequate flow is entering the diversion canal. Inspections occur more often during higher flows and accompanying heavier debris loads and during colder water temperature periods when ice forms on the racks.

A discharge channel guides the spilled water and sluiced material back to the creek downstream of the building. Water retained in the system is transported from the fine rack into a 33 inch diameter buried pipeline. A slide gate is located at the pipe entrance to regulate flow into the pipe. Normally this gate is left fully open. Approximately 1,260 ft down gradient from the beginning of the pipe system is a gate valve that controls flow into COIC's delivery system. COIC's pipe leads to a small drum screen that provides a means of bypassing fish from COIC's diversion flow back to the river (rm 4.2). The drum screen has been updated; however, the fish bypass system as a whole is presently not up-to-date and does not work effectively during low flow.

A maximum of 42 cfs of river water that does not enter COIC's water delivery system is transported through a 31 inch diameter buried pipeline approximately 5,200 ft to the hatchery. Before water enters the hatchery's rearing units it is either routed into a sand settling basin (normal operation) or to the outside screen chamber. The sand settling basin, on occasion, needs to be cleaned of sediment. The water is drawn down and any fish entrained are netted and transferred back to Icicle Creek.

From the sand settling basin, water is transported through the main pipeline to either the outside or inside screen chamber. The screens are composed of vertical static screen panels and are used to filter fish and debris from the hatchery water supply. Both screen chambers meet NOAA Fisheries 1994 standards for fish screening (NMFS 1994). However, they may not meet the more stringent criteria being developed. The area in the vicinity of the screens is monitored twice daily (once at the start and once at the end of the working day, typically 7:30AM to 4:00 PM). Observed fish are netted and returned to Icicle Creek below the spillway structure. The screens' fish bypass returns do not work properly and are no longer used. Screened river water exiting the two chambers is used in the hatchery's rearing units and then enters the discharge system or is re-used in the adult holding ponds and/or the Foster Lucas ponds before entering the discharge system.

Maintenance of the gravity intake

Sediment settles in the hatchery's intake conveyance channel and intake building sump and needs to be removed once a year to maintain the depth of the channel. This activity typically occurs in late winter or early spring but may occur any time between November 1st and June 1st. The channel is approximately 100 ft long and 10 ft wide and the depth of the sediment to be removed varies annually. The sediment in the conveyance channel is removed through flushing. This is done by first reducing the amount of flow entering the channel by placing plywood boards at the entrance rack. These boards also increase the velocity of the water remaining in the channel which helps move the sediment more effectively. The slide gate at the intake is completely closed shutting off all water to the irrigation district and hatchery. Fresh and re-used well water is supplied to fish at this time and the irrigation district temporarily shuts off. At the downstream end of the channel a series of boards used to adjust the water level in the intake building are removed. Flow is increased through the conveyance channel and water and sediment from the channel exit the intake building where the boards are removed. The sediment settles in a pool which has formed below the intake building while the water and any fish continues to flow back to Icicle Creek. In one to two hours the channel is sufficiently flushed of accumulated sediment. Boards are put back in place, the slide gate is opened, and the plywood boards at the entrance rack are removed. During all activities that may increase turbidity in Icicle Creek, LNFH staff collect water samples to measure potential increases in turbidity to ensure compliance with Water Quality Standards for Surface Waters WAC 173-201A. Additionally, a debris boom is secured approximately twenty yards upstream of the entrance rack to the conveyance channel to deflect leaves and debris from approaching the rack and entering the water conveyance channel.

Also, once a year, the diversion structure is covered with tarps secured with sand bags to prevent leaking through the boards. This is done during the low flow period in the summer to maintain

the water surface elevations necessary to meet diversion needs. Tarps are removed in early fall when stream flow increases. Once or twice a year, between November 1st and June 1st, stream flow into the diversion structure's fish ladder is reduced and the boards within the ladder are removed to flush accumulated sediments. When this occurs, the fish ladder is inoperable for two to three days. The boards in the fish ladder are adjusted to optimize fish passage when it is necessary and safe. During all activities that may increase turbidity in Icicle Creek, LNFH staff collect water samples to measure potential increases in turbidity to ensure compliance with Water Quality Standards for Surface Waters WAC 173-201A.

In 2008, a remotely operated video inspection of the upstream-most 1,457 ft of the hatchery's pipeline was conducted (BOR 2008). The overall condition of the inspected portion of the pipe was poor. Numerous transverse cracks were observed in the cement mortar lining. The cement mortar lining exhibited various stages of erosion from minor scouring to exposure of the steel cylinder along the pipe invert. It is evident from the back side of chunks of lining retrieved from the sand settling basin that the surface of the steel cylinder is corroded in some areas. The thickness of many of the chunks suggests a failure of the bond between the cement mortar lining and the steel cylinder. The areas of missing cement mortar lining observed during the inspection do not account for the number and relatively large size of the pieces of lining which have been deposited over the years in the sand settling basin. Therefore, the condition of the portion of the pipe that was not inspected is assumed to be similar, and possibly worse, than that of the inspected portion. This portion of the pipeline is scheduled to be inspected in April 2012 to determine the need for replacement.

2. Snow/Nada Lakes Supplementation Water Supply Reservoirs

During construction of the hatchery, it was recognized that stream flow and water temperatures in Icicle Creek might at times be insufficient to meet production demands. A supplementary water supply project in Snow and Nada lakes was developed and a water right of 16,000 acre feet (ac-ft) was obtained. These lakes are located approximately seven miles from the hatchery and about one mile above it in elevation. A one-half mile tunnel was drilled through granite to the bottom of upper Snow Lake and a control valve was installed at the outlet end of the tunnel. Water drains from Snow Lake to Nada Lake into Snow Creek, a tributary to Icicle Creek that enters at rm 5.5. Thus, supplemental flows from Snow Creek enter Icicle Creek one mile above LNFH's intake system. IPID has rights to 600 ac-ft of natural flow from Snow Creek.

The lakes are accessed by helicopter or foot at least twice a year, typically in July and October, to open and close the control valve. More trips may occur to adjust releases from the lakes and to perform maintenance. LNFH limits its helicopter access to the lakes as much as possible. In the past five years the lakes have been accessed by helicopter twice for maintenance and a safety inspection. Static-stilling well flow recorders at two locations help manage the reservoirs: 1) the outlet valve for upper Snow Lake and 2) the mouth of main tributary entering upper Snow Lake. Data from the recorders is managed by the USFWS Region 1 Water Rights Division in Portland, Oregon.

Recent reports by Wurster (2006) and Montgomery Water Group (2004) describe water use from the supplementation reservoirs. Both reports indicate that in most years the reservoirs are capable of providing 50 cfs of supplemental flow from approximately early July to October with a reasonable expectation of refilling the withdrawn amount by July of the following year. Providing supplemental flows of 50 cfs, to ensure LNFH can withdraw its full water right from Icicle Creek during this time frame, benefits the Icicle Creek system by reducing water temperatures and increasing flow levels when flows are typically reduced due to upstream irrigation. This commitment equates to a release of nearly 7,000 ac-ft of storage, a volume recommended by Wurster (2006) with an estimated 60% probability that inflows to upper Snow Lake will meet or exceed the released volume. Events such as prolonged equipment malfunction or two or more consecutive years of drought would alter the release operations and may result in reinitiation of consultation.

Maintenance of Water Supply Reservoirs

The equipment and facilities at the lakes/reservoirs usually require minimal maintenance. Maintenance involves periodically (approximately a couple times per year) servicing the flow gages, removing debris from the dams and flow meters, replacing batteries and conducting safety inspections when the valve is adjusted.

3. Well System

Groundwater provides the third major component of LNFH's water delivery system. The LNFH operates seven wells which produce the quality of water needed to sustain its fish production program. Five wells are located on the west bank of the hatchery channel and two are located near the hatchery's main entrance road. These wells draw water from two aquifers, one deep and one shallow. The deep-water aquifer is not influenced locally by surface water. Well 5 delivers water from this aquifer while Well 6 has the capacity to draw water from both aquifers. The shallow aquifer is influenced by surface water. Wells 1-4 and 7 draw water from the shallow aquifer. Recharge of the shallow aquifer is affected by how much surface water is present and, thus, percolates into groundwater, in the historical and hatchery channels. Water pumped from wells 4, 5, and 6 passes through an aeration chamber before entering the hatchery's pipeline system. Water pumped from wells 1, 2, 3, and 7 enters a series of aeration screens prior to entering the hatchery's pipeline system at the inside screen chamber. Well water is used to supplement and temper river water to meet production goals. Hatchery production could not be sustained year-around or for long periods of time on either river water or well water alone.

4. Water Discharge

Water diverted into LNFH's water delivery system is discharged into Icicle Creek at one of three locations: (1) at the base of the fish ladder (rm 2.8); (2) at the top of the fish ladder (used ~1 week during pre-smolt release); or (3) at the outfall for the pollution abatement ponds (~rm 2.7). The majority of river and well water used for hatchery operations returns to Icicle Creek near the base of the adult return ladder except during pond cleaning and maintenance activities when all water is routed through the pollution abatement ponds. All of the river water and groundwater

used at the hatchery, minus any leakage and evaporation, is returned to Icicle Creek (non-consumptive use).

The LNFH operates and monitors its water discharge in compliance with its National Pollutant Discharge Elimination System (NPDES) permit No. WA-000190-2. LNFH submitted an application for a new NPDES discharge permit on November 15, 2005, a draft permit is in the review process, and a new permit is to be issued in 2011. In conjunction with the new NPDES permit, WDOE issued a 401 Water Quality Certification (Order No. 7192) to LNFH (WDOE 2010). Conditions of this permit further ensure that LNFH operations and maintenance meet Washington state water quality standards.

Maintenance of Pollution Abatement Ponds

LNFH consults with the WDOE and the EPA to make sure appropriate regulations are followed when the pollution abatement ponds are cleaned and the sediment is disposed of.

D. Historical Channel (Structures 2 and 5)

When the LNFH was constructed in 1939-1941, a one mile section of Icicle Creek was used for holding and spawning adult fish (historical channel, approx. rm 2.8 – 3.8) (Figure 1). A series of structures and weirs were installed in this stream section to create ponds to hold adult salmonids prior to annual spawning. LNFH operations were conducted principally in the creek. It was operationally critical to be able to control stream flow into this channel. Therefore, a head gate (structure 2, rm 3.8) was constructed at the upstream end of the historical channel and a hatchery channel with a spillway structure at its base (rm 2.8) was built to carry high water flows around these structures. Structure 2 is composed of a concrete foundation and two radial gates. Structure 5, at the downstream end of the historical channel, is composed of a bridge with a foundation to support racks, flashboards, and/or fish traps. The historical channel was used for fish production from the 1940s to the late 1970s and seasonally as late as 2005.

From approximately 1940 to 2001, LNFH operations of structures 2 and 5 seasonally impeded fish passage and controlled surface flows between the two channels. Since 2001, LNFH has adaptively managed structures 2 and 5 to increase fish passage opportunities and improve habitat within the historical channel. The LNFH considers numerous aspects such as native fish passage and rearing, riparian habitat, water quality, health of hatchery fish, managing the number of hatchery origin spring Chinook salmon on the spawning grounds, tribal and sport fishing, flood control, and ground water recharge when adaptively managing these structures. Furthermore, LNFH works with an adaptive management group consisting of personnel from the WDFW, NOAA Fisheries, Yakama Nation, Colville Confederated Tribes, CWFO, and MCRFRO which provides recommendations for operations of structures 2 and 5. Any time structures 2 or 5 are adjusted (raising or lowering gates at structure 2, installing or removing flashboards or weirs at structure 5), it is done slowly and incrementally at a rate that avoids rapid water level changes to prevent stranding fish. However, ramping rates may be increased during emergency flood control actions. After adjustments are complete, the historical channel is surveyed for stranded fish. In the event stranded fish are observed, they will be captured and returned to the main stream channel. To date, no fish have been stranded. Additionally, when making adjustments to

structures 2 and 5, LNFH staff collect water samples to measure potential increases in turbidity to ensure compliance with Water Quality Standards for Surface Waters WAC 173-201A.

Starting in 2011, structures 2 and 5 will remain in the open position all year except if the following conditions arise: (1) 50 returning adult spring Chinook salmon pass upstream of structure 5 during broodstock collection (mid-May through early July), (2) stream flow through the hatchery channel is not sufficient to promote pre-smolt emigration during release (late April), (3) stream flow in the hatchery channel has not been sufficient enough to recharge the shallow aquifer and hatchery well production is affected (late summer, fall, and early winter), (4) high stream flows are endangering downstream infrastructure (spring runoff and rain on snow events), or (5) during maintenance of Structure 5. These conditions are discussed in more detail below and constitute the most substantive changes since the 2006 BA and 2008 BO.

1. Broodstock Collection

The broodstock collection period for spring Chinook salmon typically occurs from mid-May into early July. During this time both structures 2 and 5 will be in the fully open position. In the event 50 adult spring Chinook salmon pass upstream of structure 5, LNFH will consider alternatives along with recommendations from the adaptive management team, which may include blocking fish passage at structures 2 and 5, to further limit upstream passage of spring Chinook salmon while minimizing potential impacts to non-target taxa. The 50 fish threshold was developed by the adaptive management group. If it is necessary to block upstream passage for an extended period of time (for more than one week between May 15th and July 7th), LNFH will operate fish traps in structure 5 to capture bull trout and manually move them upstream of structure 2. Fish traps will be checked twice daily, once at the beginning and end of each day, Monday through Friday. If crowding is occurring in the traps or more than 5 bull trout are encountered in one day, the traps will be checked on weekends also. Managing the upstream passage of spring Chinook salmon is necessary to reduce the disease risk to fish rearing in the hatchery and to reduce potential impacts from interactions between the hatchery's adult Carson stock and ESA listed spring Chinook salmon if LNFH's broodstock does not enter or remain in the vicinity of the hatchery. To enumerate the number of spring Chinook salmon that have passed structure 5, a combination of survey techniques will be used including an underwater Didson fish counter (acoustical imaging sonar camera) and weekly snorkel and bank surveys.

2. Release

Salmon smolts use physiological and environmental (spring runoff) cues to initiate their downstream migration. It is beneficial for hatchery pre-smolts to emigrate quickly to reduce potential interactions with non-hatchery fish and to take advantage of fish passage spills at Columbia River dams. Therefore, LNFH may increase stream flows down the hatchery channel by lowering structure 2's radial gates to facilitate pre-smolt emigration during release in late April. This is typically necessary every year and flow is controlled for seven to ten days.

3. Aquifer Recharge

The LNFH operates seven wells which produce the quality of water needed to sustain its fish production program. Currently, LNFH needs between 1,060 and 6,590 gpm of ground water during its fish production cycle (Sverdrup 2000). The hatchery's wells draw water from two aquifers, one deep and one shallow. Wells 1-4 and 7 draw water solely from the shallow aquifer, well 5 from the deep aquifer, and well 6 draws water from both. The shallow aquifer is influenced by surface water. Recharge of the shallow aquifer is directly affected by how much water is present in the hatchery channel (GeoEngineers 1995 and BOR 2010). The hatchery channel is dewatered when the stream flow in Icicle Creek above both channels is approximately below 300 cfs and flow into the historical channel is unrestricted. Dewatering of the hatchery channel can occur in late summer, fall, and early winter for short or long periods of time. Dewatering of the hatchery channel reduces recharge to the shallow aquifer causing groundwater levels and pumping capacities to drop when wells are in production. LNFH is currently trying to quantify how much and how long water needs to be in the hatchery channel to recharge the aquifer consistent with historic well operation. Also, LNFH has installed variable frequency drive pumps on all of its wells to increase control of pumping rates and capacity. When stream flow in Icicle Creek is approximately below 300 cfs, LNFH may need to lower one or more radial gates of structure 2 for fifteen or more days at a time to ensure that enough water is in the hatchery channel for aquifer recharge (BOR 2010).

4. Flood Control

Floods and/or high stream flow events in Icicle Creek usually occur in the spring and fall and can also occur in winter with a rain on snow event. High discharge events generally last less than two weeks. To reduce potential flood damage of downstream infrastructure, LNFH may lower radial gates at structure 2 when water levels approach within one foot of the bottom of the bridge deck at structure 5 or when excessive amounts of debris accumulate on structure 2 or 5.

5. Maintenance of Structure 5

Large wood and debris can accumulate upstream of structure 5 and may need to be removed. If necessary, structure 2 will be operated to control stream flow into the historical channel to allow for the removal of debris and ensure worker safety. The need for this activity would only occur at high stream flows and would last less than one week. In the past, this activity occurred once or twice a year, however, LNFH expects the frequency of this activity to increase as the extent of time structure 2 is opened increases.

E. Conservation Measures

Conservation measures are actions to benefit or promote the recovery of listed species that are included by the federal agency as an integral part of the proposed action. These actions will be taken by the federal agency and serve to minimize or compensate for project effects on the species under review. These may include actions taken prior to the initiation of consultation or

actions which the federal agency has committed to complete in a biological assessment or similar document.

1. Aircraft

LNFH will limit the use of aircraft to access Snow/Nada lakes supplementation water supply reservoirs as much as it is feasible. This will limit possible disturbances by aircraft to species in the Alpine Lakes Wilderness Area and vicinity.

From March 1st to July 31st, LNFH will avoid taking aircraft, when flying at or below 500 ft, within 1.0 km ($\frac{2}{3}$ mile) of an active northern spotted owl nest; an activity center whose current status is unknown; or any unsurveyed potential nesting habitat. This will limit potential disturbance to the northern spotted owl during the nesting period when owls are unable to move away from disturbance. LNFH will also inform others, of this conservation measure, who have been given permission to use the hatchery's helipad. Typically, others such as the USFS and Chelan County Search and Rescue use the helipad during emergencies (i.e. forest fires, injured or lost hikers, etc.). Private use of the helipad is not allowed.

2. Fish Carcass Disposal

After spawning, LNFH will immediately dispose of spring Chinook salmon carcasses by burying them on hatchery grounds at the bottom of approximately a 10 ft deep covered hole. This will minimize the potential for carnivores/scavengers including the grizzly bear from becoming food-conditioned. Also, this will minimize the potential for human-wildlife conflicts.

3. Bull trout Protocols for Handling and Release

LNFH will follow the protocols for handling and releasing bull trout as described in Appendix D.

4. Water Delivery System

LNFH will minimize impacts to bull trout and other fish species entrained in the water delivery system by continuing to implement the following actions:

LNFH personnel will check all of the screens and racks within the hatchery's water delivery system twice daily, once in the morning and once in the afternoon, at a minimum. If bull trout are encountered, procedures outlined in Appendix D will be followed.

LNFH will remove fish from the sand settling basin in the water delivery system monthly using a crowder and nets. If more than two bull trout are encountered during removal efforts, then removal will occur once a week until less than two bull trout are encountered. If bull trout are encountered, procedures outlined in Appendix D will be followed.

LNFH will prevent fish from exiting the sand settling basin via the overflow weir. Water level in the basin is monitored by low and high level sensors. LNFH will keep the water level in the basin below the overflow spill point.

5. Spawning/Excessing

LNFH will minimize the potential for incidental take during spawning and excessing activities by training and supervising all individuals assisting in these activities in identifying and handling bull trout.

6. Fish Passage

To increase the opportunity for upstream passage for bull trout past hatchery structures, LNFH will implement the following:

Structures 2 and 5 will remain in the open position all year except if the following conditions arise: (1) 50 returning adult spring Chinook salmon pass upstream of structure 5 during broodstock collection (mid-May through early July), (2) stream flow through the hatchery channel is not sufficient to promote pre-smolt emigration during release (late April), (3) stream flow in the hatchery channel has not been sufficient enough to recharge the shallow aquifer and hatchery well production is affected (late summer, fall, and early winter), (4) high stream flows are endangering downstream infrastructure (spring runoff and rain on snow events), or (5) during maintenance of structure 5. Furthermore, LNFH will work with an adaptive management group consisting of personnel from the WDFW, NOAA Fisheries, Yakama Nation, Colville Confederated Tribes, CWFO, and MCRFRO which provides recommendations for operations of structures 2 and 5.

If it is necessary to impede upstream fish passage during broodstock collection for an extended period of time (for more than one week between June 1st and July 7th), LNFH will operate fish traps in structure 5 to capture bull trout and manually move them upstream of structure 2. Fish traps will be checked twice daily, once at the beginning and end of each day, Monday through Friday. If crowding is occurring in the traps or more than 5 bull trout are encountered in one day, the traps will also be checked on weekend days. Handling and release of bull trout will follow the procedures outlined in Appendix D.

At the diversion structure, LNFH personnel will remove a center flashboard near the apex of the structure and replace it with a V-notched board if the fish ladder is not operating efficiently during the summer (approximately late July through September) low stream flow period.

7. Fish Stranding

To minimize the potential for stranding fish in the historical channel, any time LNFH personnel adjust structures 2 or 5 (raising or lowering gates at structure 2, installing or removing flash boards or weirs at structure 5), it will be done slowly and incrementally at a rate that avoids rapid water level changes to prevent stranding fish. However, ramping rates may be increased during

emergency flood control actions. After adjustments are complete, the historical channel will be surveyed for stranded fish. In the event stranded fish are observed, they will be captured and returned to the main stream channel. Bull trout will be handled and released following the procedures outlined in Appendix D. Additionally, when making adjustments to structures 2 and 5 LNFH staff will collect water samples to measure potential increases in turbidity to ensure compliance with Water Quality Standards for Surface Waters WAC 173-201A.

VII. SPECIES/CRITICAL HABITAT DESCRIPTION

A. Fish

1. Bull Trout (*Salvelinus confluentus*)

The 2006 BA and 2008 BO provided a description of the status of bull trout and are hereby incorporated by reference. New information since the 2008 BO, specific to the Action Area, includes annual monitoring reports, surveys, and assessment of movement patterns. This information is described below.

a. Snorkel Surveys

Since LNFH has been increasing the opportunity for fish passage through the historical channel, migratory-sized bull trout have been observed upstream of the boulder falls (rm 5.6, rkm 9.2) in 2002, 2004, 2006, 2007, and 2009 (USFWS 2004, MCRFRO 2005, USFWS 2005, USFWS 2006, WFC 2007, Nelson et. al. 2011). Also, two migratory-sized bull trout x brook trout crosses have been documented in the upper reaches of Icicle Creek (Nelson et. al. 2011).

MCRFRO has conducted annual Icicle Creek summer snorkel surveys to enumerate bull trout since 2003. The total number of bull trout observed (all size classes) between rm 0 and 5.8 ranges between 17 (July 6, 2005) and 180 (August 4, 2004) with an average of 74 (Table 3).

b. Spawning Ground Surveys

Spawning ground surveys to enumerate bull trout redds were not conducted in Icicle Creek until 2008, when eight migratory-sized redds were located in French Creek, a tributary of upper Icicle Creek (Nelson et. al. 2009). In 2009, three resident-sized redds were reported in French Creek (Nelson et al. 2011).

c. Genetic Analysis

Genetic profiles of local populations of bull trout in the Upper Columbia Recovery Unit are currently being analyzed by USFWS Abernathy FTC. Preliminary results indicate that the number of alleles, allelic richness, and heterozygosity of bull trout in French Creek of upper Icicle Creek are comparable to other local populations with a migratory life history. The genetic diversity of the French Creek population shows no evidence of a bottleneck and French Creek bull trout appear to be

most genetically similar to other populations within the Wenatchee Basin (P. DeHaan, pers. comm. in Nelson et al. 2011).

d. Movement Patterns

In 2007, the MCRFRO began a telemetry study of adult fluvial bull trout to determine migration timing and distances, identify migration barriers and obstacles, document passage windows at natural and artificial obstacles, monitor seasonal movements, and locate spawning areas in Icicle Creek. To date, none of the bull trout tagged in lower Icicle Creek ($n = 9$) have attempted to move upstream past LNFH or attempted to pass the boulder falls rm 5.6 (rkm 9.2). Water temperatures in lower Icicle Creek and the LNFH spillway pool are cooler than the Wenatchee River and appear to offer thermal refuge and foraging opportunities for both adult and juvenile/sub-adult bull trout during the summer and early autumn. Also, water temperature and stream discharge appear to be major factors influencing bull trout movement patterns in Icicle Creek and the Wenatchee River. Tagged bull trout over-winter in the Wenatchee River or the Columbia River (Nelson et al. 2011).

2. Bull Trout Critical Habitat

In the October 16, 2010, final rule, the USFWS designated revised critical habitat for threatened bull trout under the ESA of 1973, as amended (U.S. Department of Interior 2010, 75 FR 63898). A total of 19,729 miles (31,751 km) of streams (which includes 754 miles (1,213 km) of marine shoreline) and 488,252 acres (197,589 hectares (ha)) of reservoirs and lakes were designated. The areas designated as critical habitat are located in the states of Washington, Oregon, Nevada, Idaho, and Montana. Critical habitat designations focus on areas containing the physical or biological features essential to the conservation of local populations and spawning and rearing streams of highest conservation value. Factors taken into consideration include the largest areas or populations, most highly connected populations, and areas with the highest conservation potential (i.e. the quantity and quality of physical or biological features present). Thirty-two critical habitat units (CHUs) in six recovery units were designated.

Icicle Creek is located within the Mid-Columbia River Recovery Unit/Upper Columbia Basin CHU. The entire stream channel up to the ordinary high water line is designated as critical habitat. This CHU includes portions of Chelan and Okanogan counties in Washington. A total of 579 miles (932 km) of streams and 2,553 acres (1,033 ha) of lake surface area in this CHU are designated as critical habitat. The subunits within this unit provide spawning, rearing, foraging, migratory, connecting, and overwintering habitat.

The USFWS has determined that the following Primary Constituent Elements (PCEs) are essential for the conservation of bull trout and may require special management considerations or protection:

- (1) Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.
- (2) Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

- (3) An abundant food base, including terrestrial organisms of riparian origin, aquatic macro invertebrates, and forage fish.
- (4) Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments with features such as large wood, side channels, pools, undercut banks and unembedded substrates to provide a variety of depths, gradients, velocities, and structure.
- (5) Water temperatures ranging from 2 to 15 °C (36 to 59 °F), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; stream flow; and local groundwater influence.
- (6) In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates is characteristic of these conditions. The size and amount of fine sediment suitable to bull trout will likely vary from system to system.
- (7) A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.
- (8) Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.
- (9) Sufficiently low levels of occurrence of nonnative predatory (i.e. lake trout, walleye, northern pike, smallmouth bass); interbreeding (i.e. brook trout); or competing (i.e. brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

3. Icicle Creek Bull Trout Diagnostics

Following is a discussion of the USFWS's Draft Matrix of Diagnostic/Pathways, Subpopulation Characteristics (USFWS 1998) in relation to Icicle Creek bull trout. The matrix framework "was designed to facilitate and standardize determinations of effect for Endangered Species Act (ESA) conferences, consultations, and permits focusing on bull trout". The matrix was also designed "to simplify arriving at an effects determination with a firm understanding of the status of the bull trout subpopulation in the watershed being considered for management activities, the environmental baseline (current condition) of the habitat, and how that subpopulation might be affected (beneficially or not) by changes in its habitat as a result of the proposed action(s)".

Note: The recovery/delisting criteria for bull trout is analyzed at the Recovery Unit scale not at a local (Icicle Creek) scale (Figure 3). "The goal of the draft bull trout recovery plan is to ensure the long-term persistence of self-sustaining, complex interacting groups of bull trout distributed across the species native range so that the species can be delisted" (USFWS 2002c).

a. Subpopulation Characteristics within Subpopulation Watersheds

(1) Subpopulation Size

The Icicle Creek bull trout subpopulation is one of 10 stocks in the Wenatchee River watershed. Four of the 10 stocks have been rated as healthy (Chikamin, Rock, and Phelps creeks – Chiwawa

River watershed; and Panther Creek – tributary to the White River). The remaining six stocks, including Icicle Creek, are listed as unknown (WDFW 1997, 1998, 2004, and USFWS 2002c). Very little information on the abundance and size class distribution of bull trout in Icicle Creek and its tributaries is available. Determining bull trout abundance and distribution and their limiting factors is a research need.

In 1938, twelve Dolly Varden (bull trout) were collected in the bypass trap of the Icicle irrigation ditch at rm 5.7 (Brennan 1938). Presence and absence surveys in upper Icicle Creek reported very few juvenile bull trout in the Eightmile and French creek tributaries (Brown 1992). In the mid 1990s, USFWS conducted day time snorkel surveys in the upper Icicle Creek Basin and observed 11 bull trout which represented less than 1% of the total fish observed (USFWS 1997). In 2004, 18 bull trout were observed in Jack Creek and four bull trout were observed during nighttime snorkel surveys in upper Icicle Creek which represented approximately 2% of the total fish observed (USFWS 2005). Since 1996, MCRFRO has conducted annual snorkel surveys in the spillway pool (rm 2.8) during the summer months (July – September). Surveys during May and June are not viable due to high flow velocities and turbulence. In these summer snorkel surveys, the total number of bull trout observed (all size classes) ranged from one in 2010 to 125 in 2004 (Table 4). Adult fluvial bull trout returning to the base of the spillway structure may be recruits from resident fish above the structure but they are more likely to be adults holding and straying from the Wenatchee River (WDFW 1997). Water temperatures in lower Icicle Creek and the LNFH spillway pool are cooler than the Wenatchee River and appear to offer thermal refuge and foraging opportunities for both adult and juvenile/sub-adult bull trout during the summer and early autumn (Nelson et al. 2011).

Also, MCRFRO has conducted annual Icicle Creek summer snorkel surveys to enumerate bull trout since 2003. The total number of bull trout observed (all size classes) between rm 0 and 5.8 ranges between 17 (July 6, 2005) and 180 (August 4, 2004) with an average of 74 (Table 3). In 2006 and 2007, as part of the Integrated Status and Effectiveness Monitoring Program for the Wenatchee River watershed, the USFS conducted snorkel surveys in French Creek at two randomly selected locations and found relatively high numbers of bull trout (J. Call, pers. comm. *in* Nelson 2007). The estimated total densities ranged from 1.8 to 11.8 bull trout per 100 meters squared (m^2) (Nelson 2007) which exceeds the minimum criterion of 1.5 per 100 m^2 used to determine areas critical to the maintenance of healthy populations of bull trout (Shepard et al. 1982) and compares favorably to known strongholds of bull trout in the Wenatchee Core Area.

The available information indicates that the subpopulation size is “Functioning at Risk” in the Wenatchee Core Area (USFWS 2008) and “Functioning at Unacceptable Risk” in Icicle Creek.

(2) Growth and Survival

The Wenatchee Core Area bull trout population is considered stable with a threat ranking of widespread, low severity and an overall ranking of “Functioning at Risk” (USFWS 2008). There is not enough information available on bull trout in Icicle Creek and its tributaries to determine a trend in subpopulation growth and survival. Therefore, the “subpopulation will be considered at risk until enough data is available to accurately determine its trend” (USFWS 1998).

(3) Life History Diversity and Isolation

There is a resident and fluvial life history component to bull trout in Icicle Creek. However, the extent of interactions between these two life forms is not known (USFWS 2002c). Seasonal, manmade obstacles to fish passage have been present in Icicle Creek since the early 20th century (Bryant and Parkhurst 1950). Also, several substantial, natural obstacles to fish passage occur in Icicle Creek. Emigration from the bull trout population in Icicle Creek to other subpopulations in the Upper Columbia Recovery Unit is unimpeded but seasonally immigration may be impeded from manmade and/or natural obstacles. Thus, the life history and diversity of the subpopulation is "Functioning at Unacceptable Risk."

(4) Persistence and Genetic Integrity

The Icicle Creek bull trout subpopulation is one of 10 stocks in the Wenatchee River watershed. Four of the 10 stocks have been rated as healthy (Chikamin, Rock, and Phelps creek – Chiwawa River watershed; and Panther Creek – tributary to the White River). The remaining six stocks, including Icicle Creek, are listed as unknown (WDFW 1997, 1998, 2004, and USFWS 2002c).

Genetic profiles of local populations of bull trout in the Upper Columbia Recovery Unit are currently being analyzed by USFWS Abernathy FTC. Preliminary results indicate that the number of alleles, allelic richness, and heterozygosity of bull trout in French Creek of upper Icicle Creek are comparable to other local populations with a migratory life history. The genetic diversity of the French Creek population shows no evidence of a bottleneck and French Creek bull trout appear to be most genetically similar to other populations within the Wenatchee Basin (P. DeHaan, pers. comm. in Nelson et al. 2011). Emigration from the bull trout subpopulation in Icicle Creek to other subpopulations in the Upper Columbia Recovery Unit is unimpeded but seasonally immigration into upper Icicle Creek may be impeded from manmade and/or natural obstacles.

The genetic integrity of bull trout in Icicle Creek may be affected by competition and hybridization with introduced nonnative fish species (WDFW 1997 & 1998, Nelson et al. 2011). Brook, rainbow, and lake trout have been planted in the Icicle Creek drainage. The presence of brook trout suggests hybridization as well as increased competition for habitat and forage may occur (Rieman and McIntyre 1993). In recent years, a few individual bull trout x brook trout have been documented in Icicle Creek and one has been genetically confirmed as an F1 hybrid (Nelson et. al. 2011). The available information indicates that the persistence and genetic integrity of bull trout in the Wenatchee watershed core area is "Functioning at Risk" and in Icicle Creek is "Functioning at Unacceptable Risk".

B. Wildlife

1. Canada Lynx (*Lynx canadensis*)

Status

On April 24, 2000 the Canada lynx was listed as threatened. The Canada lynx is known to occur in the state of Washington, with current population estimates of 100 to 200 individuals. In Washington, 115 Lynx Analysis Units (LAUs) were identified and lynx have been documented recently in 40 and at some time in 72 of these LAUs (Stinson 2001).

Range

Lynx were present in Alaska and Canada from the Yukon and Northwest Territories south to the U.S. border and east to Nova Scotia and New Brunswick and lynx were found in 16 states in the contiguous United States. They were present in the northeast in Maine, New Hampshire, Vermont, New York, Pennsylvania, and Massachusetts; in the western Great Lakes region in Minnesota, Wisconsin, and Michigan; in the Rocky Mountains in Oregon, Idaho, and Montana on into Utah and Colorado; and in the Cascade Mountain Range of Oregon and Washington (McCord and Cardoza 1982, Quinn and Parker 1987). In the Icicle Creek drainage three LAUs are identified, Icicle Ridge, Enchantment, and Garland.

Habitat Requirements

Lynx are wide ranging forest carnivores and occasionally move long distances away from typical habitat; these movements have been described as "exploratory movements" (Aubry et al. 2000, Squires and Laurion 2000). Mowat et al. (2000) also described long distance movements (>100km) by lynx. These movements are likely to result in observations of lynx out of "mapped" lynx habitat. Lynx occur in moist, coniferous forests that have cold, snowy winters and provide habitat for snowshoe hares (Quinn and Parker 1987, Koehler 1990, Koehler and Aubry 1994, Mowat et al. 2000, McKelvey et al. 2000, Ruggiero et al. 2000). In the west these habitats are represented by subalpine fir forests (Aubry et al. 2000). On the Okanogan-Wenatchee National Forest, these habitats are generally above 4000 ft elevation.

Lynx prey primarily on snowshoe hares; hares comprised 35 to 97% of lynx diets throughout the range (Koehler and Aubry 1994). Primary forest types that support snowshoe hare are subalpine fir, Engelmann spruce, Douglas-fir, and lodgepole pine (Hodges 2000). Landscapes with various age classes, primarily mid to advanced successional stages resulting from burns or clearcuts that support dense understory vegetation, may be more likely to support high snowshoe hare populations (Poole et al. 1996). Hodges (2000) found certain successional stages were important to snowshoe hares and horizontal cover appeared to be the important component. Koehler (1990) suggested snowshoe hares avoided clearcuts and very young stands and Conroy et al. (1979) found areas with greater interspersed habitats may receive greater use by hares. Population densities and overwinter survival are positively correlated with understory densities, particularly of conifers that provide winter forage, thermal cover, and escape cover (Adams 1959, Pease et al 1979, Wolff 1980, Litvaitis et al. 1985).

Lynx denning habitat is correlated with large woody debris, either down logs or root wads (Koehler 1990, Slough 1999, Mowat et al. 2000, Squires and Laurion 2000). These sites can be in regeneration forests (Slough 1999) or in mature conifer or mixed-conifer-deciduous forests (Koehler 1990). Stand structure appears to be of more importance than forest cover type (Mowat et al. 2000).

Lynx are generally tolerant of humans (Staples 1995). Other anecdotal reports suggest lynx are not displaced by human presence, including moderate levels of snowmobile traffic (Mowat et al. 2000). McKelvey et al. (2000) re-analyzed data collected by Koehler (1990) and Brittell (1989) in north central Washington and found habitat use by lynx was not influenced by logging roads. Apps (2000) found six lynx in the southern Canadian Rockies that crossed highways within their home ranges less than expected.

Few studies have been conducted on the effects of recreational activities on lynx (Ruediger et al. 2000). Concerns exist regarding the potential effects of winter recreational activities. Specifically, snow compaction associated with grooming for snowmobiling and cross-country skiing may provide travel routes for competitors such as coyotes, bobcats, and cougars (Koehler and Aubry 1994, Buskirk et al. 2000, Ruediger et al. 2000). Other associated factors include disturbance of den sites during the young rearing period (Claar et al. 1999).

Icicle Creek Canada Lynx

There are no recorded Canada lynx sightings in the Icicle Creek Basin (Janet Millard, USFS, Leavenworth, WA, pers. comm. 2005). Also, LNFH grounds do not contain habitat for lynx or snowshoe hare. However, Canada lynx are wide ranging forest carnivores and occasionally move long distances away from typical habitat areas. Some areas in the Alpine Lakes Wilderness Area may meet habitat requirements for lynx and their prey or be travel corridors.

2. Gray Wolf (*Canis lupus*)

Status

The gray wolf is listed as endangered under the ESA (U.S. Department of Interior 1978). Gray wolves originally occupied much of the continental United States but currently occupy a small portion of their former range (Laufer and Jenkins 1989). In 1930, it was believed that breeding populations of wolves in Washington were extinct because of fur trading pressure in the 1800's followed by the establishment of bounties on all predators in 1871 in the Washington Territory (Young and Goldman 1944). The last reported wolf shot in the North Cascades was in 1975 (WDW 1975, as reported in Almack et al. 1994). Recent observations indicate that wolves exist in Washington, likely in small numbers, and mostly as individuals. However, several family units have been documented, indicating that some level of reproduction has occurred recently (Almack and Fitkin 1998).

Range

The probable range of gray wolves in Washington is in the Cascade Mountains and northeastern Washington (Almack and Fitkin 1998). In northeastern Washington, the majority of the reported

wolf activity is in the eastern half of the Colville National Forest and Colville Indian Reservation and on adjacent private and public lands (Hansen 1986).

Habitat Requirements

The habitat of the gray wolf is listed as open tundra and forests (Whitaker 1980). However, gray wolves can use a variety of habitats as long as cover and a food supply are available (Stevens and Lofts 1988). They tend to focus on areas that are free from human disturbance and harassment, have low road densities, and which support large numbers of prey species (deer, elk, goat, moose, and beaver). While they may consume some small mammals, most of their diet consists of deer (Peterson 1986).

Wolves follow the movements of ungulate herds (deer, elk, and moose) across openings and through forested areas. The major tree species in these areas include white pine, lodge pole pine, Douglas fir, larch, subalpine fir, grand fir, and a number of less common species including ponderosa pine, whitebark pine, spruce, hemlock, and red cedar (Hansen 1986). Wolves have territories ranging from 70-800 mi². Wolves generally live in packs made up of 2 to 12 or more family members and individuals lead by a dominant male and female. Denning by wolves generally occurs between April and June. Den sites are often characterized by having forested cover nearby and by being distant from human activity. The pups remain at the denning site for the first six to eight weeks and then they move to a rendezvous site until they are large enough to accompany the adults on a hunt (Peterson 1986). Once the pups are large enough to go hunting, the pack travels throughout its territory.

Icicle Creek Gray Wolf

The project area lies within habitat for gray wolves in Washington State. There have been no confirmed sightings of gray wolves in the project area. In 1992, a solicited howling response of an individual was confirmed as a Class I sighting in the Alpine Lakes Wilderness Area, approximately 15 miles from the project area (Gaines et al. 1995). There is no known denning or rendezvous sites present in the project area. There are potential denning sites available less than one mile to the southwest of the project area, in the boulder fields at the base of Wedge Mountain, and 4.5 miles to the southwest in the Alpine Lakes Wilderness Area, which may also provide potential rendezvous sites. Prey base for gray wolf includes deer and elk and smaller mammals including beaver and marmot which are found readily throughout the project area and surrounding landscape. Deer and elk use the hatchery grounds for transition habitat between winter and summer habitats.

3. Grizzly Bear (*Ursus arctos*)

Status

The grizzly bear was listed as a threatened species in the coterminous United States in 1975. Livestock depredation control, habitat deterioration, commercial trapping, unregulated hunting, and protection of human life were the leading causes of the decline of grizzly bears (USFWS 1993). Two of the six ecosystems identified in the grizzly bear recovery plan (USFWS 1993) include areas in Washington, the Northern Cascades and the Selkirks. Almack et al. (1994) estimated the 1991 grizzly bear population in the North Cascades recovery area at less than 50,

and perhaps as low as five to 20. Wielgus et al. (1994) estimated a density of one bear per 27 mi² (71 km²) for the U.S. portion of the Selkirks Ecosystem and one per 17 mi² (43 km²) for the Canadian portion of the Selkirks Ecosystem.

Range

In Washington, the grizzly's range is limited to the Northern Cascades and the Selkirk mountains.

Habitat Requirements

Grizzly bear habitat use is determined by isolation from human disturbance, food distribution, food availability, and denning security. In general, grizzly bears move seasonally, using low elevation riparian areas and meadows in the spring, higher elevations during the summer and fall months, and high isolated areas for winter denning.

Little is known about the grizzly bears residing in the North Cascades. It is suspected that their habits are similar to bears from other areas, but telemetry studies are needed. Information presented here is from studies in the Selkirk Mountains and other areas. Denning occurs most commonly on north facing slopes above 6000 feet elevation in areas where snow drifts and remains through warm spells (USFS 1994b). Grizzly bears leave their den sites after the cubs are born in February. They move quickly down to low elevation areas and feed on winter killed ungulates and new growth. Grizzly bears generally feed on emerging grasses, forbs, and budding shrubs in the spring. As green-up moves up-slope, the bears follow, foraging above 3000 ft in the summer. Grizzly bears breed on their summer range between May and July. In late summer and fall, bears forage on berries such as huckleberry, serviceberry, rose, and strawberry. In September or October bears move to high elevations and denning sites. Grizzly bears may concentrate their use in mixed shrub fields, snow chutes, old burns, meadows, and cutting units. Human disturbance, usually increased with road access into grizzly habitat, is known to affect bear use of seasonal habitat components. Habituation or avoidance may result. In general, roads increase the probability of bear-human encounters and human-induced mortality (USFS 1994b).

Icicle Creek Grizzly Bear

Historically, grizzly bears were found throughout the Wenatchee National Forest. Research has confirmed the presence of a small, reproducing, and well distributed number of grizzly bears within the North Cascades Grizzly Bear Ecosystem (Almack et al. 1994); the project area lies within this recovery area. No estimates of density or total populations of grizzly bears have been made for this ecosystem. No grizzly bears have been observed in the project area, though the nearest known occurrence was an autumn track observation in forested habitat less than three miles south (USFS 1991). Grizzlies are wide-ranging and the Peshastin and Icicle Bear Management Units should be considered occupied in the larger scale. However, it is unlikely that grizzly bears occupy the project area. There are no known grizzly bear denning sites in the project area. The main hatchery grounds have food sources for grizzly bear including fawning habitat, spring emergence vegetation, and spawning salmon. The project area does not have any core habitat, areas with no motorized roads or trails, and no high use non-motorized roads or trails within 0.3 miles. The project is in a high use area except for the Snow Lakes Basin.

4. Northern Spotted Owl (*Strix occidentalis caurina*)

Status

The northern spotted owl was listed as federally threatened in June 1990. The Northern Spotted Owl Recovery Team reported about 3,602 known pairs of spotted owls in Washington, Oregon, and California with 671 pairs in Washington (USDI 1992b). Based on two sets of assumptions to develop estimates, Holthausen et al. (1994 in WDNR 1997) estimated 282 or 321 pairs of spotted owls on the Olympic Peninsula which was higher than previous estimates.

A demographic analysis of results from five sites distributed throughout the spotted owls range indicated that female, territorial spotted owls were declining between 6 to 16 % per year (an average of 10%) at individual study sites (Anderson and Burnham 1992 in WDNR 1997). Burnham et al. (1994 in WDNR 1997) estimated an annual loss of 3-8% of the resident female owls on the Olympic Peninsula using unadjusted estimates of juvenile survival. Using an adjusted estimate of juvenile survival, they estimated an annual loss of 1% of the resident females. Threats to existing populations of spotted owls include declining habitat, low populations, limited and highly fragmented habitat, isolation of populations, predation, and competition (USDI 1992b).

Range

The northern spotted owl is one of three subspecies (northern, California, and Mexican) and occurs from British Columbia to northern California. The northern spotted owl is associated with late successional and old growth forest habitats. The owl also occurs in some younger forest types where the structural attributes of old growth forests are present (WDNR 1997). The present range of the northern spotted owl is similar to the limits of its historic range (USDI 1992a).

Habitat requirements

Detailed accounts of the taxonomy, range, and habitat requirements of northern spotted owls may be found in the 1990 Fish and Wildlife Service status review; the 1987 and 1989 status review supplements, and the Interagency Scientific Committee Report (Thomas et al. 1990).

Spotted owls nest, roost, and feed in a wide variety of habitat types and forest stand conditions throughout their distribution with most observations in areas having a component of old growth and mature forests. Owls in managed forests usually occupy areas with structural diversity and a high degree of canopy closure containing large diameter or residual old trees in stands more than 60 years old (USDI 1992b).

Nesting habitat is generally found in mature and old growth stands and contains a high degree of structural complexity (WDNR 1997). Cavities or broken-top trees are more frequently selected in older forests and platforms (mistletoe brooms, abandoned raptor and gray squirrel nests, and debris accumulations) tend to be selected more frequently in younger forests (LaHaye et al. 1992). Roosting habitat has characteristics similar to nesting habitat, i.e. high canopy closure, a multi-layered canopy, and large diameter trees (WDNR 1997). Spotted owls roost in shady spots near streams in the summer (WDNR 1997). Spotted owls begin their annual breeding

cycle in late winter (February or March) and dispersal of juvenile owls begins in early fall (USDI 1992b).

Feeding habitat appears to be the most variable of the major habitat categories (Thomas et al. 1990); however, it is characterized by high canopy closure and complex structure (USDI 1992b). Spotted owls feed on a variety of small forest mammals, birds, and insects. Spotted owls on the Olympic Peninsula depend primarily on flying squirrels (Carey et al. 1992).

Although habitat that allows spotted owls to disperse may be unsuitable for nesting, roosting, or foraging, it provides an important linkage among blocks of nesting habitat both locally and over the range of the northern spotted owl. This linkage is essential to the conservation of the spotted owl. Dispersal habitat, at minimum, consists of forest stands with adequate tree size and canopy closure to protect spotted owls from avian predators and to allow the owls to forage at least occasionally (USDI 1995).

Icicle Creek Northern Spotted Owl

The project area lies within the range of the northern spotted owl. One half mile to the south of the LNFH on National Forest lands lies the Boundary Butte Late Successional Reserve (LSR). This LSR was burned over in the 1994 Rat Creek Fire, though it is still managed to protect and enhance conditions of late-successional forest ecosystems and related species. Prior to the 1994 fires there were three spotted owl activity centers within a 2 mile radius of the LNFH; there is now only one activity center within two miles of LNFH, SO-717 (Lower Mill Creek). The 1994 fires burned the activity centers and home ranges of SO-728 (Wedge/Icicle), SO-716 (Upper Mill Creek), and SO-717 (Lower Mill Creek). SO-728 (T24, R17, and S34) was last located in 1994 and SO-716 (T23 R17 S3) in 1987. After consultation with USFWS (Bush 1995) these sites are no longer considered activity centers.

The Lower Mill Creek activity center, SO-717 (T23 R17 S1) was last located in 1995, however, it is still considered an activity center and is still being monitored. The activity center for SO-717 is just over 1.8 miles from the main LNFH grounds. A nesting spotted owl pair (Wedge-Allen) was detected on Wedge Mountain (T23 R17 S10 NE ¼) in May 2001 approximately three miles S-SW of the project area (Rolf Larson, USFS, Leavenworth, WA, pers. comm. 2001). Surveys are still being conducted to determine reproductive status for this pair.

Most of the hatchery grounds are currently non-habitat for spotted owls. Northern spotted owl surveys were conducted to protocol (USFS 1992) in habitat within one mile of the project area and no spotted owls were detected. However, the forested lands adjacent to the project area provide connectivity for spotted owls moving across the landscape from the Swauk and Boundary Butte LSRs to the Icicle and Deadhorse LSRs.

VIII. CURRENT CONDITION OF HABITAT

Following is a discussion of the current habitat conditions in Icicle Creek from its confluence with the Wenatchee River to its headwaters located at Lake Josephine. The current condition of habitat is evaluated in terms of the USFWS Matrix of Diagnostics/Pathways and Indicators (1998). For a summary of baseline habitat conditions see Table 2.

A. Water Quality

1. Temperature

High and low temperature extremes occur in all reaches of Icicle Creek. Icicle Creek is on the Washington State 303(d) Clean Water Act list for not meeting temperature criterion (WDOE 2008). Water temperatures in summer months can exceed 15°C (59°F) and during the winter temperatures can fall below 1°C (34°F) (WRWSC 1998). Temperatures as high as 21°C (70°F) have been recorded in Icicle Creek (Mullan et al. 1992). The USFS 1994a stream survey conducted from August 13 to October 17 reported a maximum temperature of 18°C (64°F) and a minimum of 8°C (47°F) with temperatures in rm 4.8 to 17 not meeting Forest Plan standards. The USFS stream temperature monitoring (1997) information indicates that temperatures in Icicle Creek exceeded the Wenatchee National Forest and Washington State Water Quality standards on 15 days for the maximum temperature and 37 days for the seven day average temperature. This happened in 1997 when flows were above average all year due to the extensive snow pack received the previous winter. Water temperatures are highest in August. Water temperatures at the Chatter Creek station, located 10 miles upstream of all water diversions, do not consistently meet requirements for bull trout incubation, rearing, spawning, or migration and may limit bull trout production. Fish may migrate downstream to the Wenatchee River to avoid unfavorable conditions; however, this river is also on the state's 303(d) list for not meeting temperature standards. Water temperatures in the main stem Wenatchee River may fall below 10°C (50 °F) during the winter and rise above 15°C during the summer (WRWSC 1998).

The available information on water temperatures in Icicle Creek indicate that this criterion is "Functioning at Unacceptable Risk."

2. Sediment/Turbidity

High sediment loads occur, and historically occurred, in Icicle Creek. All of the dominant land types in the Icicle Creek watershed have high sediment delivery hazards and background hill slope erosion rates for the watershed are high and estimated to total over 4,500 tons/year (USDA 1995). Sediments are filling pools and embedding channel substrates. USFWS biologists conducted five Wolman (1954) pebble counts in the stream restoration project below LNFH in 1998 and 1999. The amount of substrate less than 2 millimeter (mm) in size ranged from 13 to 32% with an average of 24% in 1998, and 6-26% with an average of 18% in 1999. Additionally, a few pebble counts were conducted in the lower reach. Substrate less than 2 mm in size in these patches ranged from 3 to 9%. Sediment in spawning gravels was not assessed during the USFS 1994a stream survey. However, high sediment delivery rates were reported in a majority of the

upper reaches surveyed. The surveyors also reported that sedimentation appeared to be a problem throughout the system. USFWS biologists conducted four pebble counts in the upper reaches of the Icicle Creek in 1999 during a spawning gravel survey. The amount of substrate less than 2 mm in size recorded in these counts ranged from 0 to 15%.

The limited information on sediment in Icicle Creek indicates that this criterion is "Functioning at Risk."

3. Chemical Contamination/Nutrients

In 2008, WDOE updated its list of impaired waters in Washington State. Water quality concerns in Icicle Creek and the main stem Wenatchee River include not meeting Washington State 303(d) standards for water temperature, dissolved oxygen, pH, in-stream flow, total polychlorinated biphenyls (PCBs), and ammonia-N (WDOE 2008). Also, the Wenatchee River does not meet standards for 2,3,7,8-TCCDD TEQ and 4,4'-DDE (WDOE 2008).

The limited information available indicates that this criterion is "Functioning at Unacceptable Risk."

B. Habitat Access

1. Physical Barriers

Seasonal, manmade obstacles (rm 2.8 – 3.8, rm 4.5, & rm 5.7) to fish passage have been present in Icicle Creek since the early 20th century (Bryant and Parkhurst 1950). Also, several substantial, natural obstacles to fish passage occur in Icicle Creek. Emigration from the bull trout population in Icicle Creek to other subpopulations in the Upper Columbia Recovery Unit is unimpeded but seasonally immigration may be impeded from manmade and/or natural obstacles.

The available information indicates that this criterion is "Functioning at Risk."

C. Habitat Elements

1. Substrate Embeddedness

High sediment loads occur and historically occurred in Icicle Creek. All of the dominant land types in the Icicle Creek watershed have high sediment delivery hazards, and background hill slope erosion rates for the watershed are high and estimated to total over 4,500 tons/year (USDA 1995). Sediments are filling pools and embedding channel substrates. Visually assessed substrate embeddedness in the lower reaches of Icicle Creek is greater than 30%. The USFS 1994 Icicle Creek stream survey of stream reaches in the upper Icicle reported that all reaches had embedded substrate with the percentage of units embedded per reach ranging from 31 - 100%.

The limited, available data indicates that this criterion is "Functioning at Unacceptable Risk."

2. Large Woody Debris

In the winter of 1998, USFWS biologists surveyed the lower 2.8 miles of Icicle Creek. In this section, woody material is limited with only 4-10 pieces of wood observed. Urbanization, livestock grazing, and road building in the lower part of Icicle Creek has reduced the riparian zone in structure and function. Eleven percent of the riparian vegetation along the lower portion of Icicle Creek, below LNFH, has been removed for housing developments (WRWSC 1998). Thus, sources for short and long-term recruitment of large woody debris (LWD) are lacking. Stream reaches in upper Icicle Creek do not meet Northwest Forest Plan standards for LWD per mile (USFS 1994a). Higher elevation stream reaches contain more LWD. However, these reaches are in the Alpine Lakes Wilderness Area and must meet west side criteria (USFS 1994a). In the USFS 1994 stream survey, LWD was measured in terms of Northwest Forest Plan standards. From information presented in the survey report, it appears that three of the six reaches surveyed meet the matrix criterion for LWD. Sources for short and long-term recruitment have been reduced by human and natural activities in the upper Icicle.

Overall, the available information indicates that this criterion is "Functioning at Risk."

3. Pool Frequency and Quality

The wetted width of lower Icicle Creek ranges from 40 to 65 ft. Recommended pools per mile for streams this wide are 23 to 26. This criterion is not met. The pools that do exist are deep (> 1 m); however, there is no cover for fish other than depth. Lower Icicle Creek lacks features such as woody debris and large boulders that function in pool creation and maintenance. Pool volume has been reduced by deposition of fine sediments. Summer pool water temperatures are not known but temperatures in excess of 21°C (70°F) have been reported for Icicle Creek (Mullan et al. 1992). The pool frequency and quality in the upper reaches of Icicle Creek do not meet Forest Plan standards (USFS 1994a). Additionally, a review of the 1994 stream survey data shows that all reaches of the upper Icicle do not meet the matrix criterion for pool frequency. Pool water temperatures are not known, but low and high temperatures have been recorded in the upper reaches of Icicle Creek.

The available information indicates that this criterion is "Functioning at Unacceptable Risk."

4. Large Pools

Although Icicle Creek does not meet matrix pool frequency and quality standards, the available data shows that all reaches of Icicle Creek contain a few large pools with residual depths greater than 1 meter (3.3 ft) deep. Therefore, this criterion is "Functioning at Risk".

5. Off-channel Habitat

In lower Icicle Creek there are few backwater areas and low energy off-channel areas. Off-channel habitat in the lower Icicle is limited mainly by residential development and road

building. For example, there are several off-channel areas along East Leavenworth Road that are no longer connected to the stream. USFS stream survey data (1994) shows that 72% of upper Icicle Creek contains an adequate and diverse amount of off-channel habitat. Many side-channels, backwater areas, ponds, wetlands, and oxbows occur.

Overall, the available information indicates that this criterion is "Functioning Appropriately".

6. Refugia

This criterion is directly related to the off-channel habitat criterion above. However, this criterion also considers human impacts and habitat connectivity within the watershed. In lower Icicle Creek off-channel habitat is limited in quantity and connectivity and there is a high rate and potential of human impacts. In upper Icicle Creek there is an adequate and diverse quantity of off-channel habitat. Distribution and connectivity of high quality habitat is moderate and the level of human activity, mainly recreation, is high.

Overall, the available information indicates that this criterion is "Functioning at Risk."

D. Channel Condition and Dynamics

1. Width/Depth Ratio

Rivers and streams act as indicators of environmental stress when sediment supply and channel adjustments occur due to deforestation, changes in vegetation composition, urbanization, road building, and other watershed activities that create their cumulative impacts on river and stream systems. For example, in the lower reach of Icicle Creek, channel features are not being maintained over time and deposition and erosion are occurring causing it to be in a state of flux. This instability is a result of Icicle Creek adjusting to natural and human impacts to achieve a stable dimension, pattern, and profile that are in equilibrium with its gradient, sediment supply, and discharge. Channel width/depth ratios in lower Icicle Creek are increasing and entrenchment ratios are decreasing in response to increases in sediment supply and bank instability, decreases in riparian vegetation structure and function, and changes in flow regime. Consequently, the creek is becoming shallower and wider. Reaches in upper Icicle Creek are functioning adequately except in areas where roads and bridges confine the stream channel and where riprap has been placed. Five site specific areas, at road mile 4.6-5.1, 9.9-10.1, 10.7-10.8, 13.6-14.1, and Ida Campground, exist where the road system has confined the stream channel and has cut off the floodplain.

Data on width/depth ratios has not been fully documented in Icicle Creek. The limited, available information indicates that this criterion is "Functioning at Risk."

2. Stream Bank Condition

Urbanization, livestock grazing, and road building in the lower part of Icicle Creek has reduced the riparian zone in structure and function. Eleven percent of the riparian vegetation along the

lower portion of Icicle Creek, below LNFH, has been removed for housing developments (WRWSC 1998). Many large areas of the stream's banks were eroded during the 1995/96 winter floods (WRWSC 1998). In upper Icicle Creek, bank erosion ranges from minimal in most reaches to 11% in one reach (USFS 1994a).

Overall, the available qualitative and quantitative data indicates that this criterion is "Functioning Appropriately."

3. Floodplain Connectivity

Off-channel habitat in the lower Icicle is limited mainly by residential development and road building. For example, there are several off-channel areas along East Leavenworth Road that are no longer connected to the stream. In several areas of the lower reach, riprap has been placed on stream banks and berms have been built to confine the stream and limit flood damage.

Additionally, in several areas of the lower reach, wetlands have been reduced either through draining and/or filling them. Floodplain connectivity is limited in upper Icicle Creek in areas where roads and bridges confine the stream channel and where riprap has been placed. Five site specific areas, at road mile 4.6-5.1, 9.9-10.1, 10.7-10.8, 13.6-14.1, and Ida Campground, exist where the road system has confined the stream channel and has cut off the floodplain.

Overall, the available information indicates that this criterion is "Functioning at Risk."

E. Flow/Hydrology

1. Change in Peak/Base Flows

Surface flows of Icicle Creek are continuously measured at a USGS gauge station (# 12458000) located at rm 5.8. This gauging station is located above all water withdrawal operations in the watershed. This is the only consistently monitored flow data available for Icicle Creek. Daily mean flow data for water years 1936 to 1971 and from 1993 to present are available from the USGS office in Spokane, Washington. Real-time data are currently not available. There is no gauging station data available for the 1971 - 1992 water years. The available data from water years 1937-1999 show the annual mean flow of Icicle Creek, at the gauging station, to be 630 cfs. The lowest daily mean flow at this location was 44 cfs, recorded on November 30, 1936, and the highest daily mean was 14,100 cfs, recorded on November 29, 1995. In general, lowest daily flows are experienced during September and October although daily mean flows of less than 100 cfs have occurred September through February. Most high flow events occur in May and June (95%) with 5% in late fall (USFS 1995).

The discharge of Icicle Creek has been altered by water diversions since 1905 which can reduce the flow in the lower reaches to very low levels during the summer and early fall (WRWSC 1998). The City of Leavenworth (1912, 3 cfs year round) and the IPID (1910, 117 cfs irrigation season) divert water above the Snow Lakes trailhead (rm 5.7) and LNFH (1942, 42 cfs year round) and COIC (1905, 12 cfs irrigation season) divert water below the trailhead (rm 4.5). Irrigation diversions can remove 48% and 79% of the mean August and September flows,

respectively (Mullan et al. 1992). To assure water for LNFH in the summers, a supplementary water supply (16,000 ac-ft) was developed in the Snow/Nada Lakes Basin, about seven miles from LNFH and one mile above it in elevation. IPID also supplements its irrigation flows from four other high elevation lakes (Appendix A).

Icicle Creek, a Class AA stream, is listed under the Washington State 303(d) Clean Water Act for not meeting in-stream flow standards (WDOE 2008).

The available information on Icicle Creek stream flows indicates that this criterion is "Functioning at Unacceptable Risk."

2. Increase in Drainage Network

No data is available describing increases in the drainage network of Icicle Creek. Related information is presented below.

There is a strong correlation between increases in roads and other hard surfaces (i.e. buildings, parking lots, roof tops, etc.) and increases in drainage network. In Icicle Creek commercial and residential development and road and trail building has potentially affected the drainage network.

As the overall significance of potential affects to this criterion is unknown, it is rated as "Functioning Appropriately".

F. Watershed Conditions

1. Road Density and Location

Currently, the open road density in the Icicle Creek watershed averages 0.4 road miles per mi^2 (D. Driscoll, USFS, Leavenworth, WA, 2001) which is better than the recommendation for no more than one mile per mi^2 . However, in lower Icicle Creek the road density is much higher than the watershed average. There are many valley bottom roads in all reaches of Icicle Creek.

The limited, available data indicates that this criterion is "Functioning Appropriately."

2. Disturbance History

The Icicle Creek watershed has a long history of human impacts beginning with sheep herding and mining in the late 1800s. Recent uses include timber harvest, road building, fire suppression, campground development, private residences, commercial development, and recreation. Five percent of Icicle Creek's watershed, outside of the Wilderness boundary, has been directly impacted by logging (USFS 1994). Road building has occurred for development, recreation, and timber harvest. Over 11% of the vegetation along lower Icicle Creek has been removed from private property (WRWSC 1998). The Icicle Creek watershed is a popular recreation area for hikers, rock climbers, fishermen, and many others. Natural disturbances such as fires and landslides are prevalent in the watershed. In the Icicle Creek watershed, land development, road

and trail building, natural disturbances, and the majority of recreation occur within riparian reserves and along Icicle Creek and its tributaries.

The limited, available information indicates that this criterion is "Functioning at Risk."

3. Riparian Conservation Areas

The structure and function of the riparian zone has been reduced throughout the watershed. Riparian vegetation has been reduced and removed from urbanization, commercial development, roads and trails, timber harvest, campground development, and other human impacts. Natural disturbances such as fires and landslides have also impacted the riparian zone. In impacted areas, cover from shade and large woody debris recruitment has been reduced (USFS 1994a). In many impacted areas, especially along roads, invasive weeds (i.e. knapweed) have been established.

The limited, available information indicates that this criterion is "Functioning at Risk."

4. Disturbance Regime

Natural disturbances are prevalent in the Icicle Creek watershed. Wildfires are common in portions of the drainage. There have been three large fires in the past 11 years (1994, 2001, and 2004) that have burned approximately 15% of the Icicle Creek watershed. From 1996 to 1999, five landslides/avalanches occurred in the watershed. The flow regime of Icicle Creek is variable and flashy. Floods and droughts occur frequently. The measured flow in Icicle Creek ranges from a minimum of 44 cfs to a maximum of 14,100 cfs according to readings taken from the USGS gauging station located above all the major water diversions. Natural processes are unstable in the lower reaches and in several areas of the upper Icicle.

The limited, available information indicates that this criterion is "Functioning at Risk."

G. Integration of Species and Habitat Conditions

There is insufficient information on the characteristics of the bull trout subpopulation to reliably assess a population trend. There is a resident and fluvial life history component to bull trout in Icicle Creek. However, the extent of interactions between these two life forms is not known (USFWS 2002c). Seasonal, manmade obstacles to fish passage have been present in Icicle Creek since the early 20th century (Bryant and Parkhurst 1950). Also, several substantial, natural obstacles to fish passage occur in Icicle Creek. Emigration from the bull trout population in Icicle Creek to other subpopulations in the Upper Columbia Recovery Unit is unimpeded but seasonally immigration may be impeded from manmade and/or natural obstacles. Therefore, this criterion is considered "Functioning at Risk".

H. Climate Change

Climate change and the related warming of global climate have been well documented in the scientific literature (Bates et al 2008; ISAB 2007; WWF 2003). Climate change has the potential

to profoundly alter aquatic habitat through both direct and indirect effects (Bisson et al. 2008). Direct effects are evident in alterations of water yield, peak flows, and stream temperature. Indirect effects, such as increased vulnerability to catastrophic wildfires, occur as climate change alters the structure and distribution of forest and aquatic systems. In the Pacific Northwest, most models project warmer air temperatures, increases in winter precipitation and decreases in summer precipitation. The research indicates that temperatures in many areas will continue to increase due to the effects of global climate change. According to model predictions, average temperatures in Washington State are likely to increase between 1.7 °C and 2.9 °C (3.1 °F and 5.3 °F) by 2040 (Casola et al. 2005). Warmer temperatures will lead to more precipitation falling as rain rather than snow. As the snow pack diminishes, stream flow timing will change, and peak flows will likely increase (Littel et.al. 2009). Higher ambient air temperatures will likely cause water temperatures to rise (ISAB 2007).

Bull trout rely on cold water throughout their various life stages and increasing air temperatures likely will cause a reduction in the availability of suitable cold water habitat. Climate change is already affecting the frequency and magnitude of fires, especially in the warmer, drier regions of the west, and the fires may act on an altered forest community in the future (Bisson et al. 2008). In several studies related to the effect of large fires on bull trout populations, bull trout appear to have adapted to past fire disturbances through mechanisms such as dispersal and plasticity. However, as stated earlier, the future may well be different than the past and extreme fire events may have a dramatic effect on bull trout and other aquatic species, especially in the context of continued habitat loss, simplification and fragmentation of aquatic systems, and the introduction and expansion of exotic species (Bisson et al. 2008).

Impacts on hydrology associated with climate change will cause shifts in timing, magnitude, and distribution of peak flows that are also likely to be most pronounced in high elevation stream basins (Battin et al. 2007, Littel et. al. 2009) that currently provide cold water for bull trout spawning and incubation. Although lower elevation rivers are not expected to experience as severe an impact from alterations in stream hydrology, they are generally not cold enough for bull trout spawning, incubation, and juvenile rearing.

There is still a great deal of uncertainty associated with predictions of timing, location, and magnitude of climate change. It is also likely that the intensity of effects will vary by region (ISAB 2007). However, the long term water quality monitoring data and several studies have revealed that climate change does have the potential to impact ecosystems throughout the state of Washington (ISAB 2007, Battin et al. 2007, Rieman et al. 2007, Littel et. al. 2009). There is little doubt that climate change is and will be an important factor affecting bull trout distribution. As distribution contracts, patch size decreases and connectivity is truncated; populations that are currently connected may become thermally isolated, which could accelerate the rate of local extinction beyond that resulting from changes in stream temperature alone (Rieman et al. 2007). It is vital to maintain or restore stream temperatures as close to natural conditions as possible if bull trout and other cold-water dependent species are to persist.

It is likely that in the future, the hydrograph of Icicle Creek will change as more precipitation falls as rain and the snowpack in the watershed diminishes. The duration and magnitude of

current summer/fall low flow conditions may increase as would water temperatures. Currently, water temperatures in many areas of Icicle Creek do not meet bull trout life history requirements. Changes in the hydrograph would also likely limit connectivity with other subpopulations. Bull trout subpopulations in the Wenatchee Core Area would experience similar circumstances.

IX. ANALYSIS OF EFFECTS TO ESA LISTED SPECIES

A. Fish

1. Bull Trout (*Salvelinus confluentus*) and Bull Trout Critical Habitat

Potential effects to bull trout and its critical habitat may occur from the following LNFH operations and maintenance activities:

a. Fish Production

(1) Broodstock Collection and Holding

During operation of the adult return fish ladder from approximately the middle of May through the first week of July, bull trout may voluntarily enter the adult fish ladder and holding ponds. During weekly sorting and counting, large bull trout that are encountered in the holding ponds are captured and released according to protocols outlined in Appendix D. In the past ten years only one bull trout has been encountered in the adult holding ponds. Small bull trout that fit between the crowder bars may avoid capture and remain in the holding ponds until they are drained via the fish ladder at the end of the spawning season (late August). The small fish observed in the holding ponds have typically been spring Chinook salmon. No small bull trout have been observed. Although conditions in the holding ponds are maintained to promote fish health, bull trout may experience stress, overcrowding, warm water temperatures, and chemical (formalin) treatments. The formalin (Parasite-S, Western Chemical) used in hatchery operations is FDA approved for use on salmonids and the manufacturer's guidelines are followed. The hatchery typically treats adult fish in the pond at 167 ppm for one hour using the flow through method. The manufacturers label recommends treating salmonids up to 170 ppm for water temperatures below and up to 250 ppm for temperatures above 50°F. Water temperatures in the adult ponds during treatment are above 50°F. Additional treatments may be administered upon recommendation from a Fish Health Specialist. Treatment water exiting the adult ponds is diluted from additional hatchery discharge before it enters Icicle Creek. Hatchery broodstock collection and holding operations may affect bull trout through holding, capturing, and handling. LNFH broodstock collection and holding has no effect on bull trout critical habitat PCEs.

(2) Release

All 1.2 million spring Chinook salmon pre-smolts are force released directly from the rearing unit to Icicle Creek approximately during the third week in April. However, an emergency release could occur at any time.

Direct competition for food and space between hatchery and natural fish (bull trout) may occur in spawning/or rearing areas and the migration corridor, but often more intensely between individuals of the same species. These impacts are assumed to be greatest in the spawning and nursery areas and at points of highest fish density (release areas) and to diminish as hatchery smolts disperse (BAMP 1998). However, LNFH spring Chinook salmon would not be expected to spawn in areas typically associated with bull trout spawning and thus there is little to no effect to the bull trout subpopulation.

Release of hatchery smolts that are physiologically ready to migrate is expected to minimize competitive interactions as they should quickly migrate out of the spawning and rearing areas (NMFS 1995). Competition continues to occur at some unknown, but probably lower level as smolts move downstream through the migration corridor (BAMP 1998). Rearing and release strategies are designed to limit the amount of ecological interactions occurring between hatchery and naturally produced fish. Fish are reared to sufficient size that smoltification occurs within nearly the entire population which reduces retention time in the streams after release (Bugert et al. 1991). Witty et al. (1995) state they did not find any literature or data to demonstrate a functional relationship between numbers of juvenile migrants moving through reservoirs and impacts on smolt survival attributable to competition.

Hatchery fish may prey upon natural fish. There is currently no evidence that hatchery released fish prey on bull trout or prey species for bull trout. It is more likely that hatchery fish provide a substantial prey base for bull trout. Due to their location, size, and time of emergence, newly emerged Chinook salmon fry are likely to be the most vulnerable to predation by hatchery released fish (USFWS 1994). Emigration out of hatchery release areas and foraging inefficiency of newly released hatchery smolts may minimize the degree of predation (USFWS 1994).

Witty et al. (1995) conclude that the potential impact of hatchery salmonid predation on natural salmonids in the main stem corridor is not a significant factor. Steward and Bjornn (1990) state that large concentrations of hatchery fish may adversely affect wild juveniles by stimulating functional responses from bird and non-salmonid fish predators. On the other hand, a mass of fish moving through an area may confuse or distract predators and may provide a beneficial effect (BAMP 1998).

Hatchery reared salmon and steelhead released into spawning and rearing areas of natural species may fail to emigrate (residualize), and may negatively interact with natural fish (BAMP 1998). Releases from LNFH are timed to mimic the out-migration of naturally produced salmon to further reduce potential residuals. Precocious maturation of male Chinook salmon is common, suggesting that it is a characteristic of this behavioral form (Mullan et al. 1992). They also indicate that precocious maturation of male spring Chinook salmon is common in the mid-Columbia Basin and is characteristic of both hatchery and wild stocks. Examination of 3,443 juveniles from the Lemhi River, Idaho, showed that precocious development existed in 2.6% of the sample (Gebhards 1960). Precocious males constituted about 1% of 20,000 wild Chinook salmon examined in tributary streams of the mid-Columbia River 1983 - 1988 (Mullan et al. 1992). Precocious males tend to have a higher mortality rate than non-maturing juveniles

(Chapman et al. 1995). Mullan et al. (1992) found that precocious males made up a greater percentage of the fish that died at LNFH. Precocious males also tend to be less nomadic than other juveniles. In Icicle Creek, Mullan et al. (1992) reported that males generally remained in the test area while females migrated.

Spring Chinook salmon released from LNFH may, but are unlikely to, compete with bull trout. Released fish are more likely to have a beneficial effect on bull trout and their critical habitat (PCE 3) by providing a prey base.

b. Water Supply System

(1) Point of Diversion and Gravity Flow Delivery System

Bull trout and connectivity between bull trout critical habitat (PCE 2) in Icicle Creek may be affected by LNFH's intake facilities by impeding passage at the low head diversion structure, impingement on the outer grizzly rack's fencing, entrainment into the water delivery system, and sediment removal (PCE 4). Fish passage past the low rubble masonry diversion structure (rm 4.5) may occur over the structure or through a pool and weir fish ladder. A V-notch has been cut into a center board to aid fish passage over the structure at low flows. Fish passage past the diversion structure and through its fish ladder at extreme low stream flows may be impeded. However, at extreme low flows, water level and temperature would prevent fish passage in many areas of Icicle Creek below the structure minimizing the potential effect of LNFH's diversion structure.

From mid-July through September, LNFH staff may place a section of cyclone fence (plastic coated, 4 inch mesh) in front of the outer grizzly rack to prevent adult spring Chinook salmon from entering the conveyance channel due to disease concerns. Bull trout may also be prevented from becoming entrained in the water delivery system during this time period. Bull trout may also become impinged on the fencing. However, in 2010, the first year this activity was implemented, no fish became impinged. Overall, the hatchery's intake is not effectively screened at its initial point of diversion and bull trout may become entrained in the gravity flow delivery system. The gravity flow system delivers a maximum of 42 cfs through a 31 inch diameter buried pipeline approximately 6,460 ft to the hatchery. Before water enters the hatchery, it is either routed into a sand settling basin (PCE 4) (normal operation) or to the outside screen chamber prior to entering the rearing units. The sand settling basin, on occasion, needs to be cleaned of sediment. The water is drawn down and any fish entrained are netted and transferred back to Icicle Creek. From the sand settling basin, water is transported through the main pipeline to one of two separate screen chambers, the outside and inside screen chambers. These screens, which are composed of vertical static screen panels, are used to filter fish and debris from the hatchery water supply. Both screen chambers meet the NOAA Fisheries' standards for fish screening (NMFS 1994). However, they may not meet the more stringent criteria being developed. The area in the vicinity of the screens is monitored twice daily (once at the start and once at the end of the working day, typically 7:30AM to 4:00 PM). Observed fish are netted and returned to Icicle Creek below the spillway structure. The screens' fish bypass returns do not work properly and are no longer used. In 2006 three (one mortality), 2007 two, 2008 two, 2009

nine (one mortality), and in 2010 three (one mortality) bull trout were removed from LNFH's intake facilities. All bull trout were handled and released according to protocols established between LNFH and CWFO (Appendix D).

Sediments accumulate upstream of the diversion structure, within the pool and weir fish ladder, and in the conveyance channel and periodically need to be removed. Sediments are flushed occasionally from upstream of the diversion structure and within the pool and weir ladder through the removal of boards. Sediments that settle in the conveyance channel from the diversion structure to the intake pipe need to be removed nearly every year to maintain the depth of the channel. The channel is approximately 100 ft long and 10 ft wide and the depth of the sediment to be removed annually varies. Sediments are flushed from the conveyance channel by first reducing the amount of flow entering the channel by placing plywood boards at the entrance rack. These boards also increase the velocity of the water remaining in the channel which helps move the sediment more effectively. The slide gate at the intake is completely closed shutting off all water to the irrigation district and hatchery. Fresh and re-used well water is supplied to fish at this time and the irrigation district temporarily shuts off. At the downstream end of the channel a series of boards used to adjust the water level in the intake building are removed. Water and sediment from the channel exit the intake building where the boards are removed. The sediment settles in a pool which has formed below the intake building while the water and any fish continues to flow back to Icicle Creek. In a matter of a few hours the channel is sufficiently flushed of accumulated sediment. Boards are put back in place, the slide gate is opened, and the plywood boards at the entrance rack are removed. The flushing of sediments from intake facility structures has a limited, temporary potential to affect bull trout and its habitat (PCE 4) immediately downstream of the structures.

These operations may, but are unlikely to, affect bull trout and its critical habitat. Bull trout entrained in the gravity flow delivery system may be affected by harming, holding, capturing, and handling. LNFH's gravity flow delivery system removes large quantities of sediment (sand settling basin) from Icicle Creek and therefore has a positive effect on bull trout critical habitat (PCE 4).

(2) Snow/Nada Lakes Supplementation Water Supply Reservoirs

LNFH operates the Snow/Nada lakes supplementation water supply reservoirs to add 50 cfs of supplemental flow to Icicle Creek from approximately early July to October as stream flow and water temperatures in Icicle Creek might at times be insufficient to meet production demands. This commitment equates to a release of nearly 7,000 ac-ft of storage, a volume recommended by Wurster (2006) with an estimated 60% probability that inflows to upper Snow Lake will meet or exceed the released volume. Events such as prolonged equipment malfunction or two or more consecutive years of drought would alter the release operations and may necessitate reinitiation of consultation.

Hatchery operations of the Snow/Nada lakes supplementation water supply reservoirs is likely to have a beneficial effect on bull trout and its critical habitat by increasing stream flows (PCE 7)

and decreasing water temperatures (PCE 5) below rm 5.5 (outlet of Snow Creek) during the late summer and early fall.

(3) Well System

LNFH operates seven wells which produce the quality of water needed to sustain the current fish production program. Well water is used to supplement and temper river water to meet production goals. Hatchery production could not be sustained year-around or for long periods of time on either river water or well water alone. Six of the hatchery's wells draw water from a shallow aquifer that is in hydraulic continuity with the hatchery channel. When the hatchery channel is dry, recharge of the shallow aquifer and the production of the wells are affected. The hatchery may lower the gates at structure 2 in the historical channel to control flow between this channel and the hatchery channel to increase aquifer recharge when needed. The potential affects to bull trout through the operations of structure 2 are discussed below in the Historical Channel section.

The operation of LNFH's well system to supplement and temper river water to meet production goals is likely to have a beneficial effect on bull trout and its critical habitat (PCEs 5, 7, and 1 (+ & -)) through the discharge of tempered (cooler in summer and warmer in winter compared to the ambient stream temperature) water into the spillway pool. Bull trout use the spillway pool as a holding area and as a cool or warm water refugia.

(4) Water Discharge

All of the surface and groundwater used at the hatchery, minus any leakage and evaporation, is returned to Icicle Creek (non-consumptive use). The majority of the water used for hatchery operations returns to Icicle Creek at the base of the adult return ladder (rm 2.8) except during pond cleaning and maintenance activities when all water is routed through one of two pollution abatement ponds (rm 2.7). The WDOE and EPA are consulted to make sure appropriate regulations are followed when the abatement ponds are cleaned and the sediment is disposed of. LNFH operates and monitors its water discharge in compliance with its NPDES permit (No. WA-000190-2). The permit contains limits concerning discharge, monitoring and reporting requirements, and other provisions to ensure that the discharge does not degrade water quality or people's health. In essence, the permit translates general requirements of the Clean Water Act into specific provisions tailored to the specific hatchery operations and the discharge of pollutants. LNFH submitted an application for a new NPDES permit on November 15, 2005. A draft NPDES permit is in the review process and a new permit is to be issued in 2011. In conjunction with the new NPDES permit, WDOE issued a 401 Water Quality Certification (Order No. 7192) to LNFH (WDOE 2010). Conditions of this permit further ensure that LNFH operations and maintenance meet Washington State water quality standards.

Water discharge from LNFH's operations and maintenance may, but is not likely to, affect bull trout and its critical habitat (PCE 8). LNFH follows all federal and state permits and guidance regulating discharge from a fish production facility.

c. Historical Channel (Structures 2 and 5)

LNFH's operation and maintenance of structures 2 and 5 in the historical channel may seasonally prevent upstream fish passage (PCE 2 & 7). It is unlikely that adjustments to structures 2 and 5 will prevent downstream fish passage but they may temporarily delay it. Peak upstream migration of bull trout in the Wenatchee Core Area occurs one month after peak stream flows, approximately from late June through July. Operations of structures 2 and 5 that may occur during hatchery fish release, aquifer recharge, flood control, and maintenance of structure 5 will have little to no effect on bull trout upstream migration as these activities do not occur during this time. However, bull trout upstream migration does occur during LNFH's broodstock collection period. To increase fish passage opportunities through the historical channel from past levels, LNFH will keep structures 2 and 5 in the open position except if more than 50 returning adult spring Chinook salmon pass upstream of structure 5 as previously discussed. The likelihood of this occurring is unknown but assumed to be low as returning spring Chinook salmon are imprinted on LNFH water (i.e. natal stream) and limiting periods when the fish ladder is closed may limit straying. During broodstock collection in 2010, when structure 5 remained opened and stream flow was controlled (269 cfs), MCRFRO conducted weekly snorkel surveys in the historical channel from May 14th to July 1st. No more than 5 adult spring Chinook salmon were encountered until July 1st when 30 were counted. A total of two bull trout (35-45 centimeter (cm)) were counted during these surveys. However, if it is necessary to block upstream passage for an extended period of time (for more than one week between May 15th and July 7th), LNFH will operate fish traps in structure 5 to capture bull trout and manually move them upstream of structure 2. Fish traps will be checked twice daily, Monday through Friday, or as needed. If crowding is occurring in the traps or more than five bull trout are encountered in one day, the traps will be checked on weekends also. Therefore, operations of structures 2 and 5 may affect bull trout and its critical habitat (PCEs 2 & 7) through temporarily impeding fish passage, a temporary increase of sediment (unlikely), harming, holding, capturing, and handling.

LNFH's operations and maintenance of structures 2 and 5 may impact habitat within the historical channel through seasonally controlling stream flows (PCEs 4 & 7). Icicle Creek is considered critical habitat for bull trout. Bull trout may use the historical channel for rearing and over-wintering. Prior to 2001, the historical channel was accumulating sediments which reduced the quality and quantity of fish habitat within the channel. Since 2001, when LNFH began using an adaptive management approach for operating structures in the historical channel, the quantity and complexity of habitat within the historical channel has greatly increased (PCE 4). Spawning gravels and subsequently steelhead, spring Chinook, and coho redds have appeared (Table 5). Therefore it is more likely that future LNFH operations of structures 2 and 5 will have a positive rather than negative impact on fish habitat (PCE 4) within the historical channel.

2. Icicle Creek Bull Trout Diagnostics

Following is a discussion of the USFWS's Draft Matrix of Diagnostic/Pathways, Subpopulation Characteristics (USFWS 1998) in relation to Icicle Creek bull trout. **Note:** The recovery/delisting criteria for bull trout is analyzed at the Recovery Unit scale not at a local (Icicle Creek) scale. "The goal of the draft bull trout recovery plan is to ensure the long-term

persistence of self-sustaining, complex interacting groups of bull trout distributed across the species native range so that the species can be delisted" (USFWS 2002c).

a. Subpopulation Characteristics within Subpopulation Watersheds

(1) Subpopulation Size

Information on the bull trout subpopulation size in Icicle Creek and on factors that may be affecting its abundance and size class distribution remains an important research need. LNFH operations may seasonally prevent upstream migration of adult bull trout (discussed in criteria below) and juvenile fish entrained in the water delivery system will be delayed and may be killed (3 out of 19 in the last 5 years). LNFH has been in operation for 70 years and the bull trout subpopulation in Icicle Creek still persists. Also, LNFH operations may have a positive ("Restore") effect on subpopulation size in the future by increasing the opportunity for bull trout to migrate past LNFH grounds. LNFH operations have no effect on the numerous natural and other manmade (past and present) factors which may be influencing the subpopulation size of bull trout in Icicle Creek and in the Wenatchee Core Area. However, since bull trout entrained in the water delivery system may be killed, LNFH operations and maintenance may "Degrade" this criterion in Icicle Creek. This criterion will be "Maintained" in the Wenatchee Core Area.

(2) Growth and Survival

Since there is not enough information available to determine a trend in subpopulation growth and survival, it is not possible to accurately assess potential impacts from LNFH operations and maintenance on this criterion. However, LNFH has been in operation for 70 years and the bull trout subpopulation in Icicle Creek still persists. LNFH operations may have a positive ("Restore") effect on subpopulation size in the future by increasing the opportunity for bull trout to migrate past LNFH grounds. LNFH operations have no effect on the numerous natural and other manmade (past and present) factors which may be influencing the growth and survival of bull trout in Icicle Creek and in the Wenatchee Core Area. However, since bull trout entrained in the water delivery system may be killed (3 out of 19 in the past 5 yrs), LNFH operations and maintenance may "Degrade" this criterion in Icicle Creek. This criterion will be "Maintained" in the Wenatchee Core Area.

(3) Life History Diversity and Isolation

Emigration from the bull trout subpopulation in Icicle Creek to other subpopulations in the Wenatchee Core Area and Upper Columbia Recovery Unit is unimpeded but seasonally immigration may be impeded from manmade and/or natural obstacles. Current hatchery operations increase the opportunity for adult bull trout upstream migration through LNFH grounds from the past, which may improve this criterion. Operations have no effect on other manmade and natural obstacles to fish passage in Icicle Creek or factors that influence this criterion in the Wenatchee Core Area. Thus, this criterion may be "Restored" in Icicle Creek and will be "Maintained" in the Wenatchee Core Area.

(4) Persistence and Genetic Integrity

Emigration from the bull trout subpopulation in Icicle Creek to other subpopulations in the Wenatchee Core Area and Upper Columbia Recovery Unit is unimpeded but seasonally immigration may continue to be impeded from manmade (non-hatchery) and/or natural obstacles. LNFH operations have no effect on competition and hybridization between bull trout and non-native species in Icicle Creek. LNFH has been in operation for 70 years and the bull trout subpopulation in Icicle Creek still persists. Increasing opportunities for fish passage past LNFH grounds may aid in persistence. LNFH operations have no effect on other subpopulations in the Wenatchee Core Area. This criterion will be "Maintained" at both the Icicle Creek and Wenatchee Core Area scales.

In summary, the proposed action of LNFH operations and maintenance "May affect, **is** likely to adversely affect" the bull trout subpopulation in Icicle Creek and its critical habitat. The proposed action **is not** "likely to jeopardize the continued existence of" the bull trout subpopulation in Icicle Creek. **Note:** the recovery/delisting criteria for bull trout are analyzed at the Recovery Unit scale not at a local (Icicle Creek) scale. "The goal of the bull trout recovery plan is to ensure the long-term persistence of self-sustaining, complex interacting groups of bull trout distributed across the species native range so that the species can be delisted" (USFWS 2002c).

B. Wildlife

1. Canada Lynx (*Lynx canadensis*)

There are no recorded Canada Lynx sightings in the Icicle Creek Basin (Jannet Millard, USFS, Leavenworth, WA, pers. comm. 2005). LNFH grounds do not meet the habitat requirements for this species or its prey. However, Canada lynx are wide ranging forest carnivores and occasionally move long distances away from typical habitat areas. Some areas in the Alpine Lakes Wilderness Area may meet habitat requirements for lynx and their prey or be travel corridors. Helicopter flights to the supplementation lakes to open and close the control valve and to perform maintenance have been limited but still may occur. In the past five years, the lakes have been accessed by helicopter twice for maintenance and a safety inspection. These flights may temporarily disturb Canada lynx and their prey if they are present in the vicinity of the supplementation lakes. Therefore, the operation and maintenance of LNFH "may affect is not likely to adversely affect" the Canada lynx.

2. Gray Wolf (*Canis lupus*)

The project area lies within habitat for gray wolves in Washington State. There have been no confirmed sightings of gray wolves in the project area. In 1992, a solicited howling response of an individual was confirmed as a Class I sighting in the Alpine Lakes Wilderness Area, approximately 15 miles from the project area (Gaines et al. 1995). There is no known denning or rendezvous sites present in the project area. There are potential denning sites available less than one mile to the southwest of the project area, in the boulder fields at the base of Wedge

Mountain, and 4.5 miles to the southwest in the Alpine Lakes Wilderness Area, which may also provide potential rendezvous sites. Prey base for the gray wolf includes deer and elk and smaller mammals including beaver and marmot which are found readily throughout the project area and surrounding landscape. Deer and elk use the hatchery grounds for transition habitat between winter and summer habitats. Helicopter flights to the supplementation lakes to open and close the control valve and to perform maintenance have been limited but still may occur. In the past five years, the lakes have been accessed by helicopter twice for maintenance and a safety inspection. These flights may temporarily disturb the gray wolf and its prey if they are present in the vicinity of the supplementation lakes. Therefore, the operation and maintenance of LNFH "may affect is not likely to adversely affect" the gray wolf.

3. Grizzly Bear (*Ursus arctos*)

No grizzly bears have been observed in the project area, though the nearest known occurrence was an autumn track observation in forested habitat less than three miles south (USFS 1991). There are no known grizzly bear denning sites on LNFH grounds. The main hatchery grounds have food sources for grizzly bear including fawning habitat, spring emergence vegetation, and spawning salmon. Grizzlies are wide-ranging and the Peshastin and Icicle Bear Management Units should be considered occupied in the larger scale. Helicopter flights to the supplementation lakes, in the Alpine Lakes Wilderness Area, to open and close the control valve and to perform maintenance have been limited but still may occur. In the past five years, the lakes have been accessed by helicopter twice for maintenance and a safety inspection. These flights may temporarily disturb the grizzly bear and its prey, if they are present in the vicinity of the supplementation lakes. Therefore, the operation and maintenance of LNFH "may affect is not likely to adversely affect" the grizzly bear.

4. Northern Spotted Owl (*Strix occidentalis caurina*)

Hatchery operations have no effect on nesting, roosting, foraging, or dispersal habitat for spotted owls. Most of LNFH grounds are non-habitat for spotted owls. However, the forested and private lands adjacent to LNFH property may provide connectivity for spotted owls moving across the landscape from the Swauk LSR to the Icicle LSR and the Deadhorse LSR. Helicopter flights to the supplementation lakes, in the Alpine Lakes Wilderness Area, to open and close the control valve and to perform maintenance have been limited but still may occur. In the past five years, the lakes have been accessed by helicopter twice for maintenance and a safety inspection. These flights may temporarily disturb the northern spotted owl. From March 1st to July 31st, LNFH will not take aircraft, when flying at or below 500 feet, within 1.0 km (2/3 mile) of an active northern spotted owl nest; an activity center whose current status is unknown; or any unsurveyed potential nesting habitat. This will limit potential disturbance to the northern spotted owl during the nesting period when owls are unable to move away from disturbance. Therefore, the operation and maintenance of LNFH "may affect is not likely to adversely affect" the northern spotted owl.

X. ANALYSIS OF POTENTIAL EFFECTS TO THE CURRENT CONDITION OF HABITAT
The 2006 BA and 2008 BO provided a description of the current condition of habitat and are hereby incorporated by reference.

A. Water Quality

1. Temperature

High and low temperature extremes naturally occur in all reaches of Icicle Creek. Water withdrawals during the irrigation season may cause water temperatures to increase below rm 5.7 during the summer and early fall. However, LNFH's supplementation flow decreases water temperatures from rm 5.5 to 4.5 during this time (USFWS 2006). LNFH's discharge (surface water tempered with groundwater) decreases water temperatures during the summer and early fall and increases water temperatures during the winter below rm 2.8 (Nelson et. al. 2009 & 2011, USFWS 2006). Although LNFH's operation of its water delivery system can improve ("Restore") water temperature conditions seasonally in some reaches of Icicle Creek, hatchery operations are not able to mitigate for natural conditions or other manmade effects in the Icicle Creek watershed. Therefore this criterion will be "Maintained."

2. Sediment/Turbidity

The operation of LNFH may cause infrequent, short-term increases in sediment and turbidity below rm 4.5 (intake) and rm 2.8 (structure 5) during maintenance activities. During these activities, LNFH staff collect water samples to measure potential increases in turbidity to ensure compliance with Water Quality Standards for Surface Waters WAC 173-201A. LNFH's operations decrease the amount of sediment entering areas below rm 4.5 as stream flow entering the water delivery system flows through a sediment settling basin and/or a pollution abatement pond before re-entering Icicle Creek. However, bull trout do not spawn in Icicle Creek below rm 4.5. Therefore, the proposed action will not increase or decrease sediment and turbidity in areas of bull trout spawning and incubation in Icicle Creek. This criterion will be "Maintained".

3. Chemical Contamination/Nutrients

In 2005, the USFWS conducted a study to determine the extent of PCB and pesticide concentrations in LNFH fish. Hatchery fish are not accumulating PCB or pesticides to levels of concern. In addition, the study assessed PCB and pesticide concentrations in Icicle Creek sediment above and below the LNFH and in the pollution abatement pond. Data show that there is no statistically significant difference in PCB or pesticide concentrations between sediment samples collected above the hatchery intake and below the hatchery's effluent in Icicle Creek. Thus, data show that LNFH is not a significant source of PCB's or pesticides in Icicle Creek (USFWS 2005a).

In 2005, the WDOE reported that LNFH was a point source for phosphorus loading in Icicle Creek. Sampling conducted by the WDOE in August and September 2002 indicated that most of the flow and inorganic phosphorus (inorganic-P) load in lower Icicle Creek came from the

hatchery's main outfall. The inorganic-P concentration at the outfall was approximately 13 micrograms per liter (ug/L) in both August and September 2002, a three-fold increase over the inorganic-P concentration of the water entering the hatchery's delivery system. Accounting for discharge volume, the hatchery was identified as the point source contributing a critical-condition inorganic-P load of 1.25 kg/day or 86.3% of the total load in Icicle Creek. The WDOE states that to meet water quality standards in lower Icicle Creek, the hatchery's main outfall would need to reduce its inorganic-P effluent concentration to less than 5.0 ug/L. Organic-P concentrations in the main outfall were below reporting limits. There were significant observed increases (200% to 1500% increases) in ammonia and nitrate (N) concentrations in the main outfall discharge compared to the below-reporting-limit levels of the Icicle Creek water at the hatchery diversion. An increase in inorganic-P and ammonia within the hatchery facility is most likely due to the products of fish metabolism and P addition from fish feed, although groundwater augmentation may contribute additional P and N (the hatchery well water was not sampled).

Adult spring Chinook salmon held in the holding ponds are administered a formalin treatment at least three times per week to control external fungus growth. The formalin (Parasite-S, Western Chemical) used in hatchery operations is FDA approved for use on salmonids and the manufacturer's guidelines are followed. The hatchery typically treats adult fish in the pond at 167 ppm for one hour using the flow through method. The manufacturer's label recommends treating salmonids up to 170 ppm for water temperatures below and up to 250 ppm for temperatures above 50°F. Water temperatures in the adult ponds during treatment are above 50°F. Additional treatments may be administered upon recommendation from a Fish Health Specialist. Treatment water exiting the adult ponds is diluted from additional hatchery discharge before it enters Icicle Creek.

Since 2005, LNFH has addressed environmental concerns over its discharge in several ways. First, LNFH switched to a low phosphorus feed for all life stages of fish at the hatchery except for fry which are fed starter feed for the first three months. Second, an additional abatement pond was built to increase retention time and provide operational flexibility when cleaning hatchery facilities. Last, the original abatement pond was cleaned. LNFH consults with the WDOE and the EPA to make sure appropriate regulations are followed when the pollution abatement ponds are cleaned and the sediment is disposed of. Furthermore, LNFH operates and monitors its water discharge in compliance with its NPDES permit No. WA-000190-2. LNFH submitted an application for a new NPDES discharge permit on November 15, 2005. A draft permit is in the review process and a new permit is to be issued in 2011. In conjunction with the new NPDES permit, WDOE issued a 401 Water Quality Certification (Order No. 7192) to LNFH (WDOE 2010). Conditions of this permit further ensure that LNFH operations and maintenance meet Washington state water quality standards.

LNFH operations and maintenance may have a limited effect on water quality in Icicle Creek below rm 2.7. Overall, the proposed action does not have a significant effect on water quality in the Icicle Creek watershed and proposed activities will not alter Icicle Creek's Clean Water Act 303(d) water quality designations. Thus, this criterion will be "Maintained".

B. Habitat Access

1. Physical Barriers

Seasonal, manmade obstacles to fish passage have been present in Icicle Creek since the early 20th century (Bryant and Parkhurst 1950). Also, several substantial, natural obstacles to fish passage occur in Icicle Creek. Emigration from the bull trout population in Icicle Creek to other subpopulations in the Upper Columbia Recovery Unit is unimpeded but seasonally immigration may be impeded from manmade and/or natural obstacles.

Since LNFH was built in 1939-1941, the hatchery has operated and maintained several structures in Icicle Creek which may seasonally restrict fish passage. These structures include structures 5 (approx. rm 2.8) and 2 (rm 3.8) of the historical channel and the diversion structure (rm. 4.5). Additionally, a concrete spillway structure (rm 2.8) blocks upstream fish passage into the hatchery channel.

Since LNFH has been increasing the opportunity for fish passage through the historical channel, migratory-sized bull trout have been observed upstream of the boulder falls (rkm 9.2) in 2002, 2004, 2006, 2007, and 2009 (USFWS 2004, MCRFRO 2005, USFWS 2005, USFWS 2006, WFC 2007, Nelson et. al. 2011). The current proposed action will further increase the opportunity for bull trout to migrate past LNFH grounds. However, LNFH operations have no effect on other manmade or natural fish passage obstacles in Icicle Creek. Therefore, this criterion will be "Maintained".

C. Habitat Elements

1. Substrate

The operation of LNFH may cause infrequent, short-term increases in sediment and turbidity below rm 4.5 (intake) and rm 2.8 (structure 5) during maintenance activities. During these activities LNFH staff collect water samples to measure potential increases in turbidity to ensure compliance with Water Quality Standards for Surface Waters WAC 173-201A. Also, LNFH's operations and maintenance of structures 2 and 5 may impact habitat within the historical channel through seasonally controlling stream flows. Prior to 2001, the historical channel was accumulating sediments which reduced the quality and quantity of fish habitat within the channel. Since 2001, when LNFH began using an adaptive management approach for operating structures in the historical channel, the quantity and complexity of habitat within the historical channel has greatly increased. Spawning gravels and subsequently steelhead, spring Chinook, and coho redds have appeared (Table 5). Therefore it is more likely that future LNFH operations of structures 2 and 5 will have a positive rather than negative impact on fish habitat within the historical channel. Furthermore, LNFH's operations decrease the amount of sediment entering areas below rm 4.5 as stream flow entering the water delivery system flows through a sediment settling basin and/or a pollution abatement pond before re-entering Icicle Creek. Therefore, LNFH operation and maintenance activities may have a short-term, negative ("Degrade") affect immediately below rm 2.8 and 4.5 during maintenance activities but have a positive ("Restore") affect from rm 0 to 4.5 on this criterion. However, the operation and maintenance of LNFH has

no effect on other manmade activities or natural processes that influence substrate embeddedness in Icicle Creek. Therefore, this criterion will be "Maintained."

2. Large Woody Debris (LWD)

Although maintenance of LNFH structures includes removing large wood and debris, these materials are not removed from the Icicle Creek system. All natural material removed from upstream of structures are placed downstream within the ordinary high water mark. The operation and maintenance of LNFH has no effect on other factors that influence LWD in Icicle Creek. Therefore, this criterion will be "Maintained."

3. Pool Frequency and Quality

LNFH operations and maintenance have no effect on this criterion above rm 4.5. LNFH operation and maintenance activities may have a short-term, negative ("Degrade") affect immediately below rm 2.8 and 4.5 from an increase in sediment/turbidity during maintenance activities but have a positive ("Restore") effect on this criterion from rm 0 to 4.5 through removal of sediment from the stream system. The operation and maintenance of LNFH has no effect on other factors that influence pool frequency and quality in Icicle Creek. Overall, this criterion will be "Maintained."

4. Large Pools

LNFH operations and maintenance have no effect on this criterion above rm 4.5. LNFH operation and maintenance activities may have a short-term, negative ("Degrade") affect immediately below rm 2.8 and 4.5 from an increase in sediment/turbidity during maintenance activities but have a positive ("Restore") effect on this criterion from rm 0 to 4.5 through removal of sediment from the stream system. The operation and maintenance of LNFH has no effect on other factors that influence the number of large pools in Icicle Creek. Overall, this criterion will be "Maintained."

5. Off-channel Habitat

The operation and maintenance of LNFH may have a positive ("Restore") effect on off-channel habitat through increasing stream flows below rm 5.5 during the late summer and early fall. However, LNFH has no effect on other factors that influence off-channel habitat in Icicle Creek. Overall, this criterion will be "Maintained."

6. Refugia

LNFH operations and maintenance activities may provide refugia for bull trout in the spillway pool mainly from warm water conditions. However, LNFH has no effect on other factors that influence refugia in Icicle Creek. Overall, this criterion will be "Maintained."

D. Channel Condition and Dynamics

1. Width/Depth Ratio

As stated above, LNFH operations and maintenance may have both a positive and negative effect on sediment and turbidity in Icicle Creek which may influence this criterion. The hatchery has no effect on other factors influencing this criterion in the watershed. Overall, this criterion will be "Maintained".

2. Stream Bank Condition

The operation and maintenance of LNFH has no effect on the natural processes or human activities that influence stream bank condition in Icicle Creek. Therefore, this criterion will be "Maintained."

3. Floodplain Connectivity

LNFH operations of structure 2 may have a negative ("Degrade") effect on this criterion in Icicle Creek from approximately rm 3.8 (S2) downstream to rm 2.3 (East Leavenworth Road Bridge). LNFH has no effect on other factors influencing this criterion in the watershed. Overall, this criterion will be "Maintained."

E. Flow/Hydrology

1. Change in Peak/Base Flows

Hatchery operations have a positive ("Restore") effect on summer base flows in Icicle Creek below rm 5.5. LNFH adds a supplemental flow of 50 cfs to Icicle Creek from July to October. However, LNFH is a non-consumptive water user that withdraws water at rm 4.5 and discharges at approximately rm 2.8. Also, operation of structure 2 alters the hydrograph between rm 2.8 and 3.8. Therefore, LNFH operations have a positive and negative affect on this criterion between rm 2.8 and 5.5. Hatchery operations have no effect on the many other factors influencing this criterion in the watershed. Overall, this criterion will be "Maintained".

2. Increase in Drainage Network

The operation and maintenance of LNFH has no significant effect on the natural processes or human activities that influence the drainage network in Icicle Creek. Therefore, this criterion will be "Maintained."

F. Watershed Conditions

1. Road Density and Location

LNFH does use and maintain some valley bottom roads and trails on both sides of Icicle Creek mainly between rm 2.8 and 3.8. LNFH operations have no effect on other factors influencing this criterion in the watershed. Therefore, this criterion will be “Maintained” at a watershed scale.

2. Disturbance History

The operation and maintenance of LNFH has no significant effect on the natural processes or human activities that influence the disturbance history in the Icicle Creek watershed. Therefore, this criterion will be “Maintained” at a watershed scale.

3. Riparian Conservation Areas

The operation and maintenance of LNFH has no significant effect on the natural processes or human activities that influence riparian conservation areas in the Icicle Creek watershed. Therefore, this criterion will be “Maintained” at a watershed scale.

4. Disturbance Regime

The operation and maintenance of LNFH has no significant effect on the natural processes or human activities that influence the disturbance regime in the Icicle Creek watershed. Therefore, this criterion will be “Maintained” at a watershed scale.

G. Integration of Species and Habitat Conditions

Since LNFH has been increasing the opportunity for fish passage through the historical channel, migratory-sized bull trout have been observed upstream of the boulder falls (rkm 9.2) in 2002, 2004, 2006, 2007, and 2009 (USFWS 2004, MCRFRO 2005, USFWS 2005, USFWS 2006, WFC 2007, Nelson et. al. 2011). Also, in 2008, the first year bull trout spawning ground surveys were conducted in the Icicle Creek watershed, eight migratory-sized redds were located in French Creek, a tributary of upper Icicle Creek (Nelson et. al. 2009). The current proposed action will further increase the opportunity for bull trout to migrate past LNFH grounds and, therefore, aid in restoring the life history and diversity of Icicle Creek’s bull trout population. However, bull trout that become entrained in LNFH’s water delivery system may be harmed or killed (3 out of 19 in the last 5 yrs.). LNFH has no effect on habitat or factors affecting the quality and quantity of habitat in Icicle Creek above rm 5.5 where bull trout spawn and rear. Below rm 5.5 where bull trout rear and over-winter, LNFH operations and maintenance have positive and some negative effects on stream habitat. LNFH operations increase summer/fall low flows and reduce water temperatures. Bull trout use the spillway pool as a holding area and a cool-water (summer) or warm water (winter) refugia. LNFH’s operations and maintenance of structures 2 and 5 may impact habitat within the historical channel through seasonally controlling stream flows. Prior to 2001, the historical channel was accumulating sediments which reduced the quality and quantity of fish habitat within the channel. Since 2001, when LNFH began using an adaptive management approach for

operating structures in the historical channel, the quantity and complexity of habitat within the historical channel has greatly increased. Spawning gravels and subsequently steelhead, spring Chinook, and coho redds have appeared (Table 5). Therefore it is more likely that future LNFH operations of structures 2 and 5 will have a positive rather than negative impact on fish habitat within the historical channel.

LNFH's adaptive management approach to operating structures in the historical channel has and will continue to significantly increase the opportunity for bull trout to migrate past LNFH grounds and access spawning grounds in upper Icicle Creek. Increasing accesses to areas above LNFH to migratory bull trout will aid in the recovery of this subpopulation. However, LNFH has no effect on fish habitat above rm 5.5 or on other bull trout subpopulations and their habitat in the Wenatchee Core Area. The operation and maintenance of LNFH has a positive ("Restore") and potentially a negative ("Degrade") effect on the integration of species and habitat conditions in Icicle Creek. Overall, this criterion will improve in Icicle Creek and be "Maintained" in the Wenatchee Core Area.

H. Climate Change and Potential Effects

If climate change predictions are accurate, it is likely that the duration and magnitude of summer/fall low flow conditions would increase along with stream temperatures in Icicle Creek. These changes are most likely already occurring and will continue to gradually occur. These changes would have a negative impact on Icicle Creek's bull trout subpopulation. LNFH operations and maintenance, as currently proposed, may reduce the negative impacts of climate change by increasing opportunities for bull trout to migrate upstream past LNFH grounds (increasing subpopulation connectivity), increasing summer low flows through supplementation activities, and decreasing water temperatures through supplementation activities and discharge of surface waters tempered with ground (well) water. The two critical concerns for bull trout in the future are warm water temperatures and connectivity. At some point in the future, when the direct and indirect effects of climate change pose a significant threat to bull trout subpopulation in Icicle Creek, it is likely that LNFH operations and maintenance, as currently proposed, may also potentially pose a threat through the entrainment of bull trout in the hatchery's water delivery system. However, LNFH has been in operation for 70 years and the bull trout subpopulation in Icicle Creek still persists. It is more than likely, especially with the current changes to hatchery operations, that bull trout in Icicle Creek will continue to exist for at least another 70 years. It is also more than likely that in less than 20 years, the hatchery will need to reinitiate ESA consultation because of changes to hatchery operations, ESA listings, environmental conditions, climate change predictions, etc.

XII. EFFECT DETERMINATIONS AND RESPONSE REQUESTED

Bull Trout (*Salvelinus confluentus*)

Determination:

☐ No Effect

☐ Is Not Likely to Adversely Affect

☒ Is Likely to Adversely Affect

Response Requested:

☐ *Concurrence

☐ Concurrence

☐ *Formal Consultation

☒ Formal Consultation

Bull Trout Critical Habitat

Determination:

☐ No Effect

☐ Is Not Likely to Adversely Affect

☒ Is Likely to Adversely Affect

Response Requested:

☐ *Concurrence

☐ Concurrence

☐ *Formal Consultation

☒ Formal Consultation

Canada Lynx (*Lynx canadensis*)

Determination:

☐ No Effect

☒ Is Not Likely to Adversely Affect

☐ Is Likely to Adversely Affect

Response Requested:

☐ *Concurrence

☒ Concurrence

☐ *Formal Consultation

☐ Formal Consultation

Gray Wolf (*Canis lupus*)

Determination:

☐ No Effect

☒ Is Not Likely to Adversely Affect

☐ Is Likely to Adversely Affect

Response Requested:

☐ *Concurrence

☒ Concurrence

☐ *Formal Consultation

☐ Formal Consultation

Grizzly Bear (*Ursus arctos horribilis*)

Determination:

☐ No Effect

☒ Is Not Likely to Adversely Affect

☐ Is Likely to Adversely Affect

Response Requested:

☐ *Concurrence

☒ Concurrence

☐ *Formal Consultation

☐ Formal Consultation

Northern Spotted Owl (*Strix occidentalis caurina*)

Determination:

☐ No Effect

☒ Is Not Likely to Adversely Affect

☐ Is Likely to Adversely Affect

Response Requested:

☐ *Concurrence

☒ Concurrence

☐ *Formal Consultation

☐ Formal Consultation

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XII. TABLES

Table 1: Water Rights for Leavenworth National Fish Hatchery.

CERTIFICATE #	PRIORITY DATE	SOURCE	AMOUNT
1824	03/26/1942	Icicle Creek	42 cfs (18,851 gpm)
1825	03/26/1942	Snow & Nada Lakes	16,000 acre feet
016378	08/01/1939	Groundwater (1 Wells)	1.56 cfs (700 gpm)
016379	06/01/1940	Groundwater (1 Wells)	2.01 cfs (900 gpm)
3103-A	10/16/1957	Groundwater (1 Wells)	2.67 cfs (1200 gpm)
G4-27115C	10/20/1980	Groundwater (4 Wells)	8.69 cfs (3900 gpm)

Table 2: Checklist for Documenting Environmental Baseline and Effects of Proposed Action(s) on Relevant Indicators (I = Icicle Creek & W = Wenatchee Core Area, as relevant).

Diagnostics/ Pathways:	Population &	Environmental	Baseline	Effects	Of The	Action(s)
Indicators	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk	Restore	Maintain	Degrade
<u>Subpopulation</u> <u>Characteristics:</u> Population Size		W	I	I	W	I
Growth and Survival		I & W		I	W	I
Life History Diversity and Isolation		W	I	I	W	
Persistence and Genetic Integrity		W	I		I & W	
<u>Water Quality:</u> Temperature			X	X	X	
Sediment		X			X	
Chem. Contam./Nutrients			X		X	
<u>Habitat Access:</u> Physical Barriers		X		X	X	
<u>Habitat Elements:</u> Substrate Embeddedness			X	X	X	X
Large Woody Debris		X			X	
Pool Frequency and Quality			X	X	X	X
Large Pools		X		X	X	X
Off-channel Habitat	X			X	X	
Refugia		X		X	X	
<u>Channel Cond. & Dynamics:</u> Wetted Width/Max. Depth Ratio		X		X	X	X
Streambank Condition	X				X	
Floodplain Connectivity		X			X	X
<u>Flow/Hydrology:</u> Change in Peak/Base Flows			X	X	X	
Drainage Network Increase	X				X	
<u>Watershed Condition:</u> Road Density & Location	X				X	
Disturbance History		X			X	
Riparian Conservation Areas		X			X	
Disturbance Regime		X			X	
<u>Integration of Species and Habitat Conditions</u>		X		X	X	X

Table 3: Summary of MCRFRO Icicle Creek Snorkel Surveys for Bull Trout (all size classes).

Year	2003	2004	2005	2006	2007	2008	2009	2010	Reach Summary
Survey Date	4-Aug	4-Aug	6-Jul	3-Aug	31-Jul	6-Aug	5-Aug	12-Aug	06-10 Avg/R
Area									
Gauge Station Falls – below IPID	No Data	No Data	No Data	No Data	No Data	No Data	2	0	1
Boulder Fall – Intake	No Data	No Data	No Data	4	2	2	8	3	4
Intake – Head gate	No Data	No Data	No Data	1	0	0	9	3	3
Head gate – Structure 5 (Historical Channel)	No Data	No Data	No Data	10	1	64	57	42	35
Spillway Pool	75	125	12	8	16	4	74	1	21
Structure 5 - Stump Hole	0	55	4	7	9	11	7	20	11
Stump Hole - Mouth	0	0	1	0	0	3	0	1	1
Total	75	180	17	30	28	84	157	71	74

Table 4: Summary of MCRFRO Spillway Pool Snorkel Surveys for Bull Trout (all size classes).

YEAR	# of Bull Trout
1996	8
1997	6
1998	40
1999	7
2000	40
2001	100
2002	No Data
2003	75
2004	125
2005	46
2006	8
2007	16
2008	4
2009	74
2010	1

Table 5: Historical Channel Redd Counts (2006-2010).

Year	2006	2007	2008	2009	2010
steelhead	2	0	0	0	4
spring Chinook	49	11	59	21	113
coho	46	360	24	128	35

XIV. FIGURES

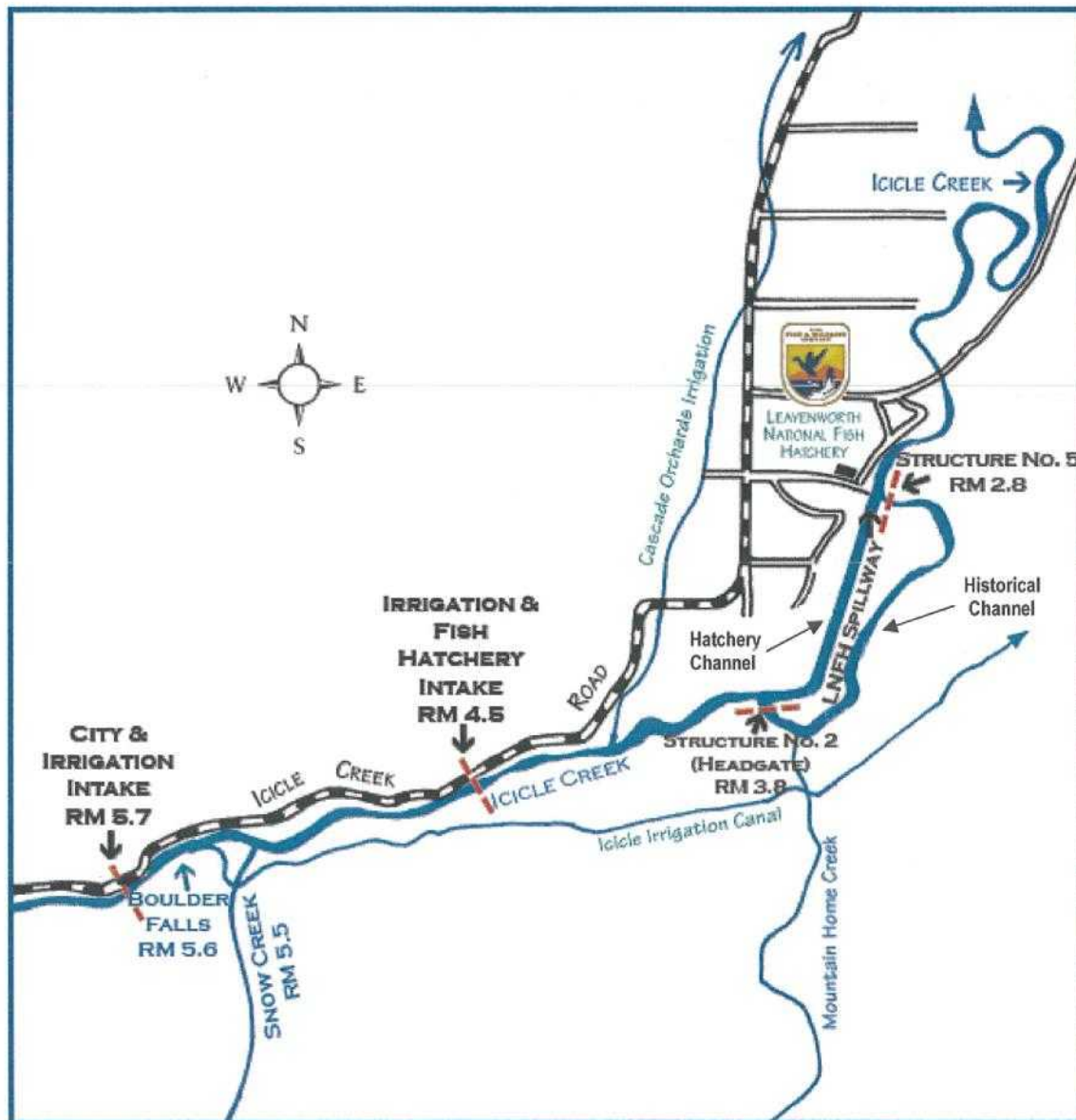


Figure 1. Leavenworth National Fish Hatchery and Vicinity



Figure 2. Map of the Icicle Creek watershed.

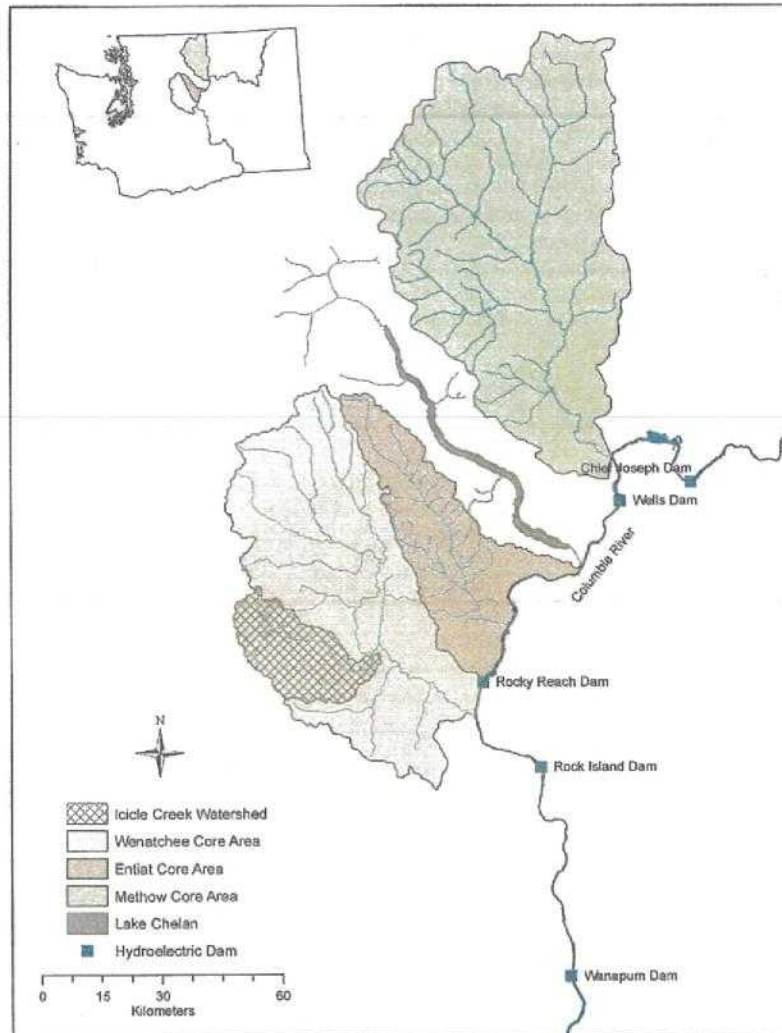


Figure 3: Map of the Upper Columbia Bull Trout Recovery Unit, showing the location of the Icicle Creek Watershed within the Wenatchee Core Area.

XVII. APPENDICES

Appendix A: Upstream Water Withdrawal

The upstream-most diversion structure on Icicle Creek is maintained and operated by the Icicle and Peshastin Irrigation Districts (IPID). Surface waters are withdrawn at this location to supply the City of Leavenworth (City) and the IPID. The IPID share ownership of some canals and water rights to storage lakes and surface waters of Icicle Creek. An agreement between the two irrigation districts governs operations. The IPID and City divert Icicle Creek surface water from opposite sides of the creek, at a diversion structure (rm 5.7) upstream of the Snow Lakes trailhead. The City has a surface water right of three cfs and withdraws water year-round (Valentine pers. comm. 2001). The IPID holds a combined water right to Icicle Creek flow of nearly 118 cfs. In general, the IPID diverts creek water from April to October, although operations may begin as early as mid-March and last until mid-October in some years (Teeley pers. comm. 2001 & 2002). Peak irrigation use is from June through August (Leonoff 1992).

The IPID's water delivery system takes water from behind the diversion structure and conveys it through an open gravity-run canal system. The ability of fish to migrate both upstream and downstream past this diversion structure is unknown. A rotating drum screen is located near the top-end of the irrigation canal and provides for fish screening. The drum screen does not meet current fish screening criteria, however the IPID is actively researching upgrading options. Any fish or debris encountered at the drum screen is returned back into Icicle Creek.

The IPID normally operates with natural flows in Icicle Creek. However, the IPID may release supplemental water from storage lakes in the upper watershed, now a part of the Alpine Lakes Wilderness Area. The IPID holds a 1929 adjudicated water right for 2,500 ac-ft each on Colchuck, Eightmile, and Klonaqua lakes. However, the recharge capacity of the storage lakes may not be as large as the water rights that are assigned to them (Leonoff 1992). Additional water rights were granted to the IPID for Square Lake (2,000 ac-ft) and Snow Lake (600 ac-ft) subsequent to the 1929 adjudication (Leonoff 1992). The IPID typically begins release of water from one upper basin lake (Colchuck, Eightmile, Klonaqua, or Square lakes) in the beginning of August and releases from a second lake towards the end of August. The IPID will rotate usage between all four lakes, using no more than two lakes in a single year to ensure sufficient storage for the following year (Teeley pers. comm.). Water released from these upper basin lakes is eventually diverted into the IPID's water delivery system at the diversion structure or directly into their irrigation canal. Water released from the lakes is used to satisfy the IPID's water rights in Icicle Creek and the rights are not in addition to the 118 cfs water right currently held (Leonoff 1992). The IPID returns excess "carrying" water to the Wenatchee River at several locations.

Appendix B: Documentation of Expected Incidental Take

Name and location of action(s): Operations and Maintenance of Leavenworth National Fish Hatchery; Icicle Creek; Leavenworth, WA.

Species: Bull trout (*Salvelinus confluentus*)

(1) The proposed action may result in incidental take through which of the following mechanisms (**bold** as appropriate)

Harm: Significant impairment of behavioral patterns such as breeding, feeding, sheltering, and others (identify). **Migration** and **Entrainment**

Harass: Significant disruption of normal behavior patterns which include, but are not limited to, breeding, feeding, sheltering, or others (identify). **Migration** and **Entrainment**

Pursue, Hunt, Shoot, **Wound, Capture, Trap, Collect.**

(2) What is the approximate duration of the effects of the proposed action(s) resulting in incidental take?

The operation and maintenance of LNFH occurs year round so the duration of some of the effects could also be year round (i.e. entrainment into the water delivery system). However, most hatchery operations and maintenance activities occur seasonally (i.e. broodstock collection).

(3) Which of the following life stages will be subject to incidental take (**bold** as appropriate)?

Fertilization to emergence (incubation)

Juvenile rearing to adulthood

Adult holding and overwintering

Adults migrating

Juveniles migrating

(4) Which life form and subpopulation status are present in the watershed or downstream of the watershed where the activities will take place (circle as appropriate)?

Life Form:

Subpopulation status:

Resident

Unknown

Adfluvial

Depressed population

Fluvial

Unknown

Anadromous

(5) What is the location of the expected incidental take due to the proposed action(s)?

Basin and watershed: Wenatchee River Basin, Icicle Creek Watershed

Stream reach and habitat units: Icicle Creek (rm 2.8-4.5)

(6) Quantify your expected incidental take:

Length of stream affected (miles): Approximately 1.7 river miles.

Individuals (if known): A maximum of 40 (3 mortalities) bull trout annually (see below).

LNFH incorporates adaptive management strategies and conservation measures into its operation and maintenance procedures to minimize its impact on the environment and ESA listed species. Since LNFH has been increasing the opportunity for fish passage through the historical channel, migratory-sized bull trout have been observed upstream of the boulder falls (rm 5.6, rkm 9.2) in 2002, 2004, 2006, 2007, and 2009 (USFWS 2004, MCRFRO 2005, USFWS 2005, USFWS 2006, WFC 2007, Nelson et. al. 2011). Also, in 2008, the first year bull trout spawning ground surveys were conducted in the Icicle Creek watershed, eight migratory-sized redds were located in French Creek, a tributary of upper Icicle Creek (Nelson et. al. 2009). Operations may negatively impact bull trout mainly during broodstock collection and surface water withdrawal. It is possible but rare that bull trout will enter the adult holding ponds during broodstock collection. In the past 10 years, only one bull trout has been encountered. The 2008 BO provided an incidental take of 20 migratory bull trout per year for delaying access to areas above LNFH from May 15th to July 7th. The current proposed action has significantly changed to increase the opportunities for bull trout to migrate past LNFH grounds during this time period. To increase fish passage opportunities through the historical channel from past levels, LNFH will keep structures 2 and 5 in the open position except if more than 50 returning adult spring Chinook salmon pass upstream of structure 5 as previously discussed. The likelihood of this occurring is unknown but assumed to be low as returning spring Chinook salmon are imprinted on LNFH

(i.e. natal stream) and limiting periods when the fish ladder is closed may limit straying. During broodstock collection in 2010, when structure 5 remained opened and stream flow was controlled (269 cfs), MCRFRO conducted weekly snorkel surveys in the historical channel from May 14th to July 1st. No more than five adult spring Chinook salmon were encountered until July 1st when 30 were counted. A total of two bull trout (35-45 cm) were counted during these surveys. However, if it is necessary to block upstream passage for an extended period of time (for more than one week between May 15th and July 7th), LNFH will operate fish traps in structure 5 to capture bull trout and manually move them upstream of structure 2. Fish traps will be checked twice daily, Monday through Friday, or as needed. If crowding is occurring in the traps or more than five bull trout are encountered in one day, the traps will be checked on weekends also. LNFH's expected annual incidental take during broodstock collection from entrainment in the adult holding ponds and potential operation of the fish traps at structure 5 is less than 20 bull trout per year.

Bull trout may also be negatively impacted through entrainment in LNFH's water delivery system. LNFH minimizes impacts to bull trout and other fish species entrained in the water delivery system by: (1) checking all of the screens and racks within the hatchery's water delivery system twice daily, once in the morning and once in the afternoon, at a minimum; (2) removing fish from the sand settling basin; (3) preventing fish from exiting the sand settling basin via the overflow weir; and (4) following procedure for handling and releasing bull trout outlined in Appendix D. In 2006 three (one mortality), 2007 two, 2008 two, 2009 nine (one mortality), and in 2010 three (one mortality) bull trout were removed from LNFH's intake facilities. These bull trout ranged in size from 140 to 382 mm (avg. 262 mm) and were entrained (84%) during the summer/fall low flow period. This potential entrainment timing trend may be a result of the orientation of the hatchery's intake structures and LNFH withdrawing a larger percentage of stream flow as flow decreases. In the current proposed action, LNFH will use its supplementation water from Snow and Nada lakes to increase stream flow in Icicle Creek by 50 cfs from July to October. An indirect effect of this operation is an increase in stream flow during the summer/fall low flow period which may reduce entrainment into the water delivery system. Also, this action increases migration opportunities and reduces water temperatures in some areas of the lower 5.5 miles of Icicle Creek. Additionally, LNFH will increase the time interval for removing entrained fish from the sediment settling basin to once a week, as necessary, from August to October. LNFH's expected incidental take from entrainment in the water delivery system is less than 20 bull trout (3 mortalities) per year.

Appendix C: USFWS Listed Species in Chelan County, Washington

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND CRITICAL
HABITAT; CANDIDATE SPECIES; AND SPECIES OF CONCERN
IN CHELAN COUNTY

AS PREPARED BY
THE U.S. FISH AND WILDLIFE SERVICE
CENTRAL WASHINGTON FIELD OFFICE
(Revised December 15, 2010)

LISTED

Bull trout (*Salvelinus confluentus*) – Columbia River DPS

Canada lynx (*Lynx canadensis*)

Gray wolf (*Canis lupus*)

Grizzly bear (*Ursus arctos horribilis*)

Marbled murrelet (*Brachyramphus marmoratus*)

Northern spotted owl (*Strix occidentalis caurina*)

Major concerns that should be addressed in your Biological Assessment of project impacts to listed animal species include:

1. Level of use of the project area by listed species.
2. Effect of the project on listed species' primary food stocks, prey species, and foraging areas in all areas influenced by the project.
3. Impacts from project activities and implementation (e.g., increased noise levels, increased human activity and/or access, loss or degradation of habitat) that may result in disturbance to listed species and/or their avoidance of the project area.

Hackelia venusta (showy stickseed)

Sidalcea oregana var. *calva* (Wenatchee Mountains checker-mallow)

Spiranthes diluvialis (Ute ladies'-tresses)

Major concerns that should be addressed in your Biological Assessment of project impacts to listed plant species include:

1. Distribution of taxon in the project vicinity.
2. Disturbance (trampling, uprooting, collecting, etc.) of individual plants and loss of habitat.
3. Changes in hydrology where taxon is found.

DESIGNATED

Critical habitat for the bull trout

Critical habitat for the Canada lynx

Critical habitat for the northern spotted owl

Critical habitat for *Sidalcea oregana* var. *calva* (Wenatchee Mountains checker-mallow)

PROPOSED

Revised critical habitat for the bull trout

CANDIDATE

Fisher (*Martes pennanti*) - West Coast DPS, west of Okanogan River
North American wolverine (*Gulo gulo luteus*) – contiguous U.S. DPS
Yellow-billed cuckoo (*Coccyzus americanus*)

SPECIES OF CONCERN

Bald eagle (*Haliaeetus leucocephalus*)
Black swift (*Cypseloides niger*)
California floater (*Anodonta californiensis*)
Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*)
Ferruginous hawk (*Buteo regalis*)
Giant Columbia spire snail (*Fluminicola columbiana*)
Kincaid meadow vole (*Microtus pennsylvanicus kincaidi*)
Loggerhead shrike (*Lanius ludovicianus*)
Long-eared myotis (*Myotis evotis*)
Northern goshawk (*Accipiter gentilis*)
Olive-sided flycatcher (*Contopus cooperi*)
Pacific lamprey (*Lampetra tridentata*)
Pallid Townsend's big-eared bat (*Corynorhinus townsendii pallescens*)
Peregrine falcon (*Falco peregrinus*)
Pygmy whitefish (*Prosopium coulteri*)
Redband trout (*Oncorhynchus mykiss*)
River lamprey (*Lampetra ayresi*)
Sagebrush lizard (*Sceloporus graciosus*)
Sharptail snake (*Contia tenuis*)
Western brook lamprey (*Lampetra richardsoni*)
Western gray squirrel (*Sciurus griseus griseus*)
Westslope cutthroat trout (*Oncorhynchus clarki lewisi*)
Astragalus sinuatus (Whited's milk-vetch)
Botrychium paradoxum (two-spiked moonwort)
Cypripedium fasciculatum (clustered lady's-slipper)
Delphinium viridescens (Wenatchee larkspur)
Petrophyton cinerascens (Chelan rockmat)
Pinus albicaulis (whitebark pine)
Silene seelyi (Seely's silene)
Trifolium thompsonii (Thompson's clover)

Appendix D: Bull trout Protocols for Handling and Release

During routine operation and maintenance at LNFH bull trout may be encountered and need to be handled to return them to Icicle Creek. To minimize harm associated with handling bull trout several precautions will occur. Prior to handling bull trout hands will be free of sunscreen, lotion, or insect repellent. When practical all bull trout handling procedures will be implemented at times that avoid temperature stress of affected fish. It may be necessary to conduct the activity in the morning or evening on hot summer days to avoid temperature stress to captured fish. If bull trout are held in a tank, a healthy environment for the stressed fish shall be provided and the holding time shall be minimized. Water to water transfers, the use of shaded, dark containers, and supplemental oxygen will all be considered in implementing fish handling operations. If a bull trout is showing signs of stress or injury, it will only be released when able to maintain itself. It may be necessary to nurture the fish in a holding tank until it has recovered. All dip net or seine mesh netting will be composed of fine mesh (no knot) material.

The release location for a captured bull trout depends on where it was captured and what river conditions prevail at that time. The general procedure is described in the table below:

<u>Capture Location</u>	<u>Release Location</u>
Adult holding pond	In the pool below the spillway structure (rm 2.8)
Trap at structure 5	Upstream of structure 2 (rm 3.8)
Inside trash rack at intake diversion	Upstream of the intake diversion structure (rm 4.5) (prevent re-entrainment)
Screen chamber/sand settling pond	Upstream of the intake diversion structure (rm 4.5) (prevent re-entrainment)
Other	Closest, safe release location in Icicle Creek